

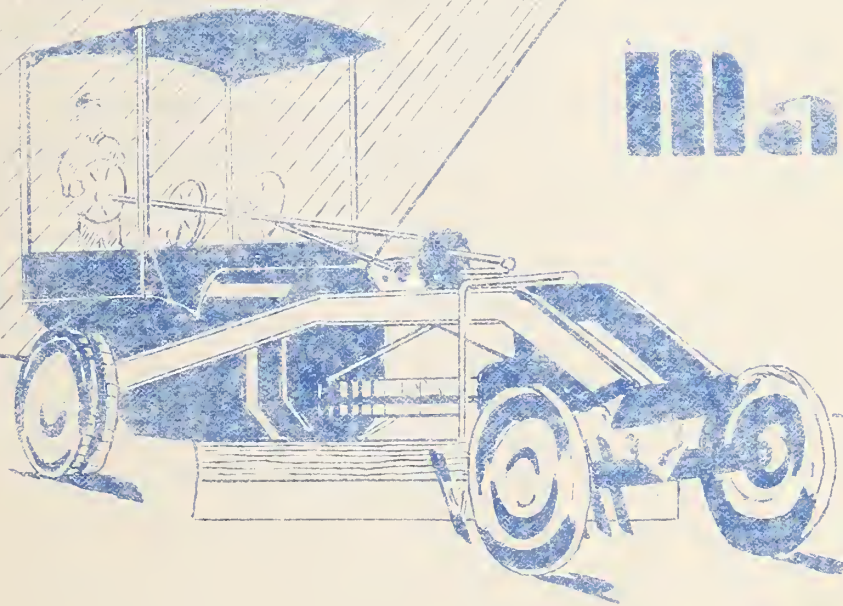
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STATE DOCUMENTS

# Maintenance Department

## Manual



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STATE OF MONTANA

STATE HIGHWAY COMMISSION

MANUAL OF INSTRUCTIONS

MAINTENANCE

First Edition

R. D. Rader, State Highway Engineer

E. B. Donohue, Maintenance Engineer

March, 1933

THE UNIVERSITY OF CHICAGO

DEPARTMENT OF THE HISTORY OF ARTS AND ARCHITECTURE

RESEARCH REPORT

1980-1981

RESEARCH REPORT

THE UNIVERSITY OF CHICAGO

DEPARTMENT OF THE HISTORY OF ARTS AND ARCHITECTURE

1980-1981

March 15, 1933

TO THE EMPLOYEES OF THE

STATE HIGHWAY COMMISSION:

This Manual is issued to develop uniformity of practice in securing a high standard, economical type of work. Individual initiative, necessary to the solution of our many problems, is to be encouraged. Any suggestions as to corrections or omissions will be appreciated.

Very truly yours,

R. D. Rader  
State Highway Engineer

By  
E. B. Donohue  
Maintenance Engineer

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MAINTENANCE DEPARTMENT  
MANUAL OF INSTRUCTIONS

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INTRODUCTION

To the maintenance organization is assigned the care and upkeep of the state highways, to the end that the investment in roads may be conserved, and that traffic may operate both safely and economically.

The general instructions contained herein are issued to secure uniformity of practice in methods developed by experience, and to impress upon each employee the necessity for sound, economical work and for satisfactory relations with the public for whose benefit our work is prosecuted.

THE UNIVERSITY OF CHICAGO PRESS

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## CHAPTER I

### ORGANIZATION AND GENERAL DETAILS

#### 1. ORGANIZATION

- 1.1                   (a) GENERAL. The Maintenance Department comprises that Headquarters           branch of the service which has assigned to it the up-Office.                   keep and restoration of roads and bridges, and the construction and upkeep of maintenance buildings and shops. The administration is under the direction of the Maintenance Engineer, at Headquarters Office, who is the representative of the State Highway Engineer in all matters pertaining thereto.
- 1.2                   The state is divided into five divisions, each in Division               charge of a Division Engineer. The Maintenance Engineer Offices.               deals directly with the Division Engineers who are responsible for the work in their respective territories. The Division Engineer is assisted in maintenance matters by Resident Engineers or Maintenance Superintendents, as requirements demand. The highways are divided into territories which vary from 200 to 450 miles and are under the direction of a Resident Engineer or Maintenance Superintendent. Each territory is in turn divided into maintenance sections, the length varying to fit local conditions. Each of these sections is under the direct supervision of a patrolman or foreman.
- 1.3                   (b) DUTIES. The Maintenance Engineer exercises general Maintenance           supervision over all maintenance activities. He has Engineer.               general supervision over the funds set aside for maintenance and recommends to the State Highway Engineer their allotment as the need arises. He advises and assists the Division Engineers in the handling of their divisions and regarding methods applicable to maintenance.

- 1.4                      The Equipment Superintendent is in charge of all main-  
Equipment                      tenance equipment, stores, and supplies. He will, under  
Superintendent                      the direction of the Maintenance Engineer, make periodic  
field inspections of all maintenance equipment and shop facilities. He will  
consult with the Division Engineers regarding all field equipment, shops, etc.
- 1.5                      The Oiling Superintendent is the representative of the  
Oiling                      Maintenance Engineer in the construction and maintenance  
Superintendent                      of oiled roads by state-operated crews. The Oiling  
Superintendent will inspect this work in detail, inform division employees  
of methods and practices in other parts of the state, and, under the direct-  
ion of the Maintenance Engineer, advise the Division Engineers regarding  
situations which should be corrected.
- 1.6                      The Division Engineer is the representative of the State  
Division                      Highway Engineer, and has charge of and is responsible  
Engineers                      for all roads within his district, including their main-  
tenance.
- 1.7                      The Resident Engineer or Maintenance Superintendent in  
Resident Engineers                      charge of a territory within the Division is field assist-  
& Maintenance                      ant to the Division Engineer. He will plan and direct  
Superintendents.                      the efforts of the foremen and patrolmen within his territory, standardize  
their methods and equipment according to accepted practice, and be responsible  
to the Division Engineer for the results obtained. He will be called upon  
from time to time for estimates, special investigations, and reports on con-  
ditions in his territory. The number of Maintenance Superintendents or  
Resident Engineers will be varied with the amount of work and the size of the  
territory.



1.8                      The maintenance foreman or patrolman is the keystone of  
Foremen                      the organization. He is removed from constant supervis-  
and                              ion of his superiors and must often act on his own  
Patrolmen                      initiative. Through his work the public forms its impression of the highway  
organization, and whether it is favorable or otherwise depends upon his  
personal conduct and efficiency in the management of his forces and equipment.  
He and his men shall at all times be courteous and helpful to the public.  
He must know his section intimately and guard it from destruction or encroach-  
ment. During rains, he should go over his road and note for future correct-  
ions all places where drainage may be faulty or structures inadequate. He  
shall inspect all bridges at frequent intervals, both foundations and super-  
structure, and report weaknesses to his superiors.

## 2. GENERAL DETAILS

1.9                      As far as possible men shall be employed in the field and  
Employment                      from the Counties in which they are to work. Promotions  
shall, if possible, be given to men already employed. Work in Montana is  
largely seasonal and Resident Engineers and Maintenance Superintendents shall  
be governed as follows in the employment, re-employment, lay-off, or release  
of personnel: Other things being equal, men with dependents shall be given  
first preference, ex-service men with dependents shall be given preference over  
non-service men; length of service with this Department shall be the second  
consideration. Available work shall be spread as far as possible, using a 4  
or 5 day week, or a 2 weeks on and one week off, plan.

1.10                      Standard personnel cards shall be prepared in full by the  
Personnel                      Resident Engineer, Maintenance Superintendent, or Foreman,  
Cards.                              and submitted to Headquarters Office, through the Division

Office, whenever a new employee is engaged. A personnel card shall not be submitted for any person who has previously worked for the Department, but a written report, showing the employee's present rating and classification, and the date he was re-employed, should immediately be forwarded through the proper channels. In order to keep the records complete at all times a written report shall also be submitted at once showing any change in an employee's rate or classification, or his transfer or release, and effective dates.

1.11                      No attempt is made to regulate the personal habits of  
Responsibility              employees but every employee is expected to attend to his  
                                 duties in a sober and industrious manner. The employees  
are representatives of the State Highway Commission and their actions are to  
be taken as indicating the morale of the whole Department. Therefore they  
shall conduct themselves at all times in such a manner that no reflection can  
be cast upon themselves or upon the Department. No loafing, visiting, or  
gossiping during working hours will be tolerated. No employee shall work un-  
der any person to whom he is related by consanguinity in the fourth degree  
and affinity in the second degree. Employees are expected to pay their  
current bills promptly, and should it be necessary for a creditor to resort  
to Headquarters or legal action for the collection of same it will be con-  
sidered sufficient cause for immediate dismissal. Unless especially  
deputized by a county sheriff or other authorized peace officer, they have no  
police power. Employees may be deputized where especial need exists. In  
such cases the authority of an officer of the law is to be used only when  
necessary for the protection of the highway or of employees.

1.12                      A pamphlet compiled by John W. Bonner is available for  
Laws.                      distribution to responsible employees. This pamphlet



contains important statutes relating to roads, highways, bridges, etc.

Executive personnel should obtain a copy of this pamphlet and familiarize themselves with such of these laws and statutes as have a bearing on their particular branch of the work.

1.13                      Maintenance crews shall leave their headquarters in time  
Working                      to be on the job at 8 o'clock each morning, and shall  
Hours.                      work on the job 8 hours from that time, exclusive of  
their lunch hour, from 12 to 1, returning to headquarters on their own time.  
Foremen shall work with their crews. In emergencies, hours of work will be directed by the foreman or his superior.

1.14                      A wage schedule for maintenance employees has been adopt-  
Wage                      ed setting forth classification, title, and rate of pay.  
Scale.                      This schedule shall be rigidly observed and all titles  
and rates of pay shown on payrolls shall agree with same.

1.15                      Standard patrolman's weekly reports shall be prepared in  
Patrolman's                      duplicate by the patrolman, foreman, or any maintenance  
Weekly Report                      employee who has been so requested, at the end of each  
week, and on the 15th of the month. The original report shall be submitted to the Resident Engineer or Maintenance Superintendent and the duplicate retained. These reports must be complete in all details.

1.16                      All transfers of employees from one district or division  
Transfers                      to another shall be immediately reported to headquarters  
of Personnel                      by letter giving full details, and the person to whom the  
employee is transferred shall be notified at once in the same manner, especially stating the last date the employee was carried on the payroll at his last assignment.

1.17 Expense accounts up to the legal amount will be allowed  
Traveling to Headquarter's employees, Division and Resident  
Expenses Engineers, and Maintenance Superintendents when away  
from their headquarters. Extra gangs such as oiling crews will be allowed  
expenses up to \$2.50 per day when moving from one assignment to another.  
Other employees, such as truck drivers, patrolmen, and foremen, may or may  
not, at the discretion of the Division Engineer, be allowed expenses up to  
the legal amount when they are on a special detail or assignment of short  
duration.

1.18 Upon reaching permanent headquarters, an employee  
Addresses assigned to take charge of work shall at once notify the  
Division Office of his postoffice, telephone and tele-  
graphic address.

1.19 Labor payrolls are to be prepared as of the 15th of each  
Payrolls month by the Resident Engineer or Maintenance Superinten-  
dent. Two copies are to be forwarded in time to reach  
the Division Office by the 17th day of the month, and the Division Office  
shall check not only the classification, rate, and time, but also the dis-  
tribution code, and send the checked, original payroll so that it will arrive  
at headquarters by the 20th of each month. The distribution of time for  
each individual on the payroll is to be shown by section prefixes, order,  
and code numbers. The payroll shall show if the employee is newly employed,  
re-employed, or released, and the dates effective in each case. In case an  
employee is transferred, the payroll shall show from whom and the date, as  
well as to whom and the date he was transferred. If an employee's rate is



changed his name and his time should appear two or more times on the payroll; once for each change of rate, showing the dates effective. In all cases, the classifications shown on the payroll shall agree with those shown on the Wage Schedule. All teams shall be carried on the payroll and shown under their owners name. Should three or more men be released at the same time, prior to the regular payroll date, a payroll on the standard form and marked "Supplementary" shall be prepared by the Resident Engineer or Maintenance Superintendent, and submitted through the regular channels rather than submitting individual claims. Any employee who has been paid by state claim should be so listed on the payroll. On all major special maintenance or betterment work, such as oiling, re-surfacing, etc., a separate payroll on the regular form shall be prepared by the timekeeper or foreman and submitted through the regular channels. With the exception of division or headquarter mechanics any person or persons assigned to this special work for a period of three days or more shall be carried on this payroll.

1.20                      Rules to be followed: A letter shall refer to a single  
Correspondence            subject in so far as practicable. The heading of all  
                             letters shall show either section designation and job  
number, or general subject, to permit ready reference and filing. Carbon  
copies of all letters, reports, and records are to be retained and filed by  
all field men. Letter books shall be used when letters are written in long  
hand. When letters relative to any part of the work are written to other  
than the Division Engineer, an extra carbon copy is to be made and forwarded  
to the Division Office. When a letter is received requesting information  
which can not be furnished within a few days, the letter should be acknowledged  
with a statement as to the probable date the required information can be fur-  
nished.

1.21 Employees shall use long distance telephone or send  
Telephone telegrams only for matters of importance requiring  
and Telegraph immediate action.

1.22 All equipment repairs and supplies are purchased by  
Freight the State with the understanding that all carrier  
and Express. charges are to be prepaid by the consignor. In case a  
shipment arrives with carrier charges collect, the charges may be taken  
care of by using state claim form #23, as the State has a credit rating  
with the Railroad Companies. When a claim of this nature is submitted a  
copy of the freight or express bill must be attached. Should a local agent  
of the Railroad or Express Company question the State's credit or right to  
settle a charge in this manner, request him to wire the auditor of his  
company for approval.

1.23 (a) EMPLOYEES. In case of accident to an employee,  
Accidents. State Industrial Accident Board Form 37, shall be  
prepared by the employee's immediate superior, and  
Form 37-A by the employee. These forms shall be mailed to the Division  
Office, which in turn will submit both forms with a letter of transmittal  
direct to the Industrial Accident Board at Helena, with a copy of the  
letter of transmittal to Headquarters Office. If the accident is fatal,  
telegraphic or telephone report shall be made immediately to the Division  
Office which in turn will notify Headquarters Office, followed by the  
usual written reports. An injured employee, who has been working by the  
hour or day, shall not be carried on the payroll while incapacitated. In  
the case of an employee working on a monthly basis a complete report of his



case shall be sent through the Division Office to headquarters office for decision as to whether or not he should be shown on the payroll. All Division and Resident Engineers, and Maintenance Superintendents should have a copy of, and familiarize themselves with, the "Workmens Compensation Act".

(b) STATE EQUIPMENT. The State Highway Commission has arranged for property damage and public liability insurance covering all motorized equipment and team graders. In case of an accident involving state equipment, report is to be made immediately, in triplicate, by the Resident Engineer or Maintenance Superintendent on the form furnished by the Insurance Company. One copy shall be submitted direct to the Insurance Company, and one each to Headquarters and Division Offices.

(c) PERSONAL LIABILITY. In case of personal injury, either to a state employee or a person not a state employee, resulting from an accident involving state equipment, all possible assistance in securing medical treatment should be given. Under no circumstances, however, shall any responsibility be assumed for the satisfaction of the fees in connection therewith as the State has no legal right or funds to take care of claims of this nature. The hospital or doctor should be given to understand that any treatment or care they may give must be settled either with the injured party, Industrial Accident Board, or the Insurance Company. Employees should not discuss facts leading up to, or present at the time of, an accident, except with department heads, other authorized officers, or representatives of the Insurance Company. Private cars or trucks shall not be used on state work without prior authorization from Headquarters Office, and even then an employee who uses a privately owned machine does so at his own risk and is liable for recovery in case of accident.

(d) REPORTS. Besides the reports on accidents mentioned above maintenance employees shall pay especial attention to all accidents both on improved highways now under maintenance and on highways under construction, and report all fatal or near fatal accidents on these roads to headquarters. Local newspaper articles, photos, and sketch maps shall be furnished with the report wherever possible.

1.24                      Requisition Form 46 shall only be used for requisition-  
Requisitions              ing office supplies, stakes, and other engineering needs.

Only one copy of this form shall be submitted to Headquarters Office. Requisition Form 76 shall be used for any other supplies, and shall be made in quadruplicate, with three copies submitted to the Division Office for approval. The approved original and duplicate shall be forwarded to headquarters. After this requisition has been taken care of at headquarters, the manner of disposal will be noted on the duplicate copy which will then be returned to the Division Office for their information. When ordering replacement parts it is necessary that the equipment number assigned to the equipment, for which the order is being made out, be given so that part numbers may be checked before the order is placed. Where no equipment number has been assigned to a unit, the part numbers, serial or manufacturer's number and all special catalogue or parts list reference should be given in detail.

1.25                      Miscellaneous reports and records are to be handled as  
Miscellaneous              the particular work may require, to secure complete  
Reports, etc.              accounting and history of progress.

1.26                    Whenever an emergency occurs, such as slides, washouts,  
Emergencies.            bridge failures, etc., which delays or endangers traffic,  
                         Headquarters Office is to be notified immediately by  
telephone or telegraph through the Division Office. The notice shall state  
the steps being taken to remedy the situation and the probable length of time  
the road will be closed or the emergency exist.





## CHAPTER II

### FUNDS AND ACCOUNTING

- 2.1 Sources of Funds. (a) FUNDS. Funds for the maintenance, repair, widening, resurfacing, and reconstruction of state highways are derived primarily from the Motor Vehicle Fuel Fund or gas tax.
- 2.2 Financial Control. (b) BUDGET. The preliminary financing of work is controlled by a system of departmental work orders. The Financial requirements of each district are to be submitted to Headquarters Office at such times as, and in the detail, requested.
- 2.3 Work Orders. (c) MAINTENANCE ALLOTMENTS. From the funds made available by budget, allotments are set up under maintenance work orders. General maintenance allotments are made to the Division for fiscal year periods. Allotments for major slide removal, special maintenance, and betterments are considered individually when requested, and must be authorized by the Maintenance Engineer prior to starting work.
- 2.4 Detail of Work and Estimate Requests for major slide, special maintenance, or betterment orders should furnish sufficient detail to clearly set forth the work proposed, and justify the cost estimate. Photographs are often of material assistance in considering the request.
- 2.5 Procedure. Standard maintenance estimate form shall be made in triplicate by the Resident Engineer or Maintenance Superintendent when requested, and submitted to the Division Office. After approval by the Division Engineer, original and duplicate

copies are forwarded to headquarters for the approval of the Maintenance Engineer. Upon approval, the duplicate copy is returned to the Division Engineer, who can then release the triplicate copy to the Resident Engineer or Superintendent in direct charge of the work.

2.6 (a) At the end of each calendar month Resident Engineers  
Monthly or Maintenance Superintendents shall submit a duplicate  
Statements. statement of all special and betterment orders under his jurisdiction to the Division Office which in turn shall forward the original to Headquarters Office and retain the copy for their files. These reports shall show section prefix, order number, original estimate, approximate amount expended, approximate amount to complete, probable date of completion, and the status, whether pending, under way, or completed. It is not intended that the field men shall keep a set of books, but some record of expenditures in connection with this class of work should be attempted.

(b) Statements of betterments and special maintenance expenditures are sent to the field by headquarters showing the status of all special maintenance and betterment orders as of the end of each calendar month.

(c) Maintenance expenditure Form 50-Revised is prepared in Headquarters Office each month and sent to the Division Office so that all field copies can be brought up to date, after which original reports are returned to headquarters.

2.7 Expenditures must not exceed work order allotments. If  
Overdrafts. the funds provided prove insufficient to defray the cost of work undertaken a supplemental request shall be made to cover the anticipated overdraft, prior to its actual occurrence, so that



the facts may be known to the Maintenance Engineer. No work shall be carried on without definite authorization.

- 2.8                    (d) MAINTENANCE ACCOUNTING. All charges under the maintenance department, with the exception of construction of construction force account items, must be classified under one of three heads, viz: General maintenance, special maintenance, and betterments.
- 2.9                    General maintenance consists of all maintenance work done by regular forces with stock equipment, and covers blading, dragging, cleaning ditches, removing weeds, etc.
- 2.10                   Special maintenance consists of purely maintenance work involving a large or unusual expense, requiring increased force and equipment. It consists of resurfacing, adding a large amount of filler, removing large slides, etc.
- 2.11                   Betterments consist of any addition to the original construction, or construction of an improved type. It consists of grade raises, line revisions, original oiling, etc.
- 2.12                   The section prefix denotes the location of the work. The counties are each numbered alphabetically, and in writing a section prefix the county serial number is used first followed by the letter "M" designating maintenance, and another letter designating the section within the county. For instance 11 MA represents the section in Dawson County between the Wibaux County line and the Prairie County line, and replaces Federal Aid Number 6, 199, 121, 213, 7, and 130.
- Accounts and Codes.
- General Maintenance.
- Special Maintenance.
- Betterments.
- Section Prefixes.

Following are the section prefixes to be used for the various counties in the state:

BEAVERHEAD COUNTY

1 MA U.S. No. 91 (241 A-B-D, 255)

BIG HORN COUNTY

2 MA U.S. No. 87-E (212, 188, 187-E,D)  
2 MI Yellowstone County Line to Hardin (5)

BLAINE COUNTY

3 MA U.S. No.2 (152, 101, 81, 23, 66)  
3 MQ Savoy Creek Bridge (80)

BROADWATER COUNTY

4 MA U.S. No. 10-N (77-D,E,F,G, 204, 30, 12)  
4 MB Townsend-Meagher County Line.

CARBON COUNTY

5 MA U.S. No. 310 (258,107,4,134)  
5 MI Rockvale-Red Lodge (106,272, and State Project)  
5 MY Black and White Trail (3)

CARTER COUNTY

6 MA Wyoming Line near Alzada to Powder River County Line (262-C)  
6 MJ Fallon County Line to Ekalaka (47)

CASCADE COUNTY

7 MA U.S. No.87, U.S.87-W,and 87-E (235-D,216, 73, 72, 64, 180, 54, 10,  
65-B & Forest Sections.)  
7 MB Vaughn-Power (211-A)  
7 MC U.S. No.91 and Great Falls-Havre (172-B,C, 182, 218, 149-A,C,D)  
7 MD Lange's Corner to Augusta (176)

CHOTEAU COUNTY

8 MA Great Falls-Havre (149-B,E, 252-C)

CUSTER COUNTY

9 MA U.S. No. 10 (158-A,B, 135-B,D)  
9 MB Jordan-Alzada (157-A,D,F, 18, 156-A,B,C)  
9 MC Miles City to Fallon County Line.

DANIELS COUNTY

- 10 MA Sheridan County Line to Scobey (251-A,B)
- 10 MB Roosevelt County Line to Scobey (266-B)
- 10 MC Canadian Line south to 251-A.

DAWSON COUNTY

- 11 MA U.S. No. 10 (234-A, 6, 199, 121, 213, 7, 150-A)
- 11 MB Glendive-Sidney (245-B,C,D)
- 11 MC Glendive-Circle (246-A,B)

DEER LODGE COUNTY

- 12 MA Butte-Anaconda-Georgetown (68-A, 68-B, 68-C, 164-A)
- 12 MB U.S. No. 10-S, Junction-Powell County (261-B)

FALLON COUNTY

- 13 MA U.S. No. 12 (86-A, 86-B, 86-C)
- 13 MI Baker-Ekalaka (48)

FERGUS COUNTY

- 14 MA U.S. No. 87-E (27, 26, 229, 112, 235-C, 235-B,D, 28)
- 14 MB Central Montana Highway (256-A,B,C,D,E)
- 14 MK Lewistown-Roy (103)

FLATHEAD COUNTY

- 15 MA U.S. No.2 (257-A,B, 99, 58-A,B,D,E - Forest)
- 15 MB U.S. No. 93 (98-B, 191-E,F, and Forest Section)
- 15 MC F.A.P. 100.
- 15 MJ F.A.P. 102.

GALLATIN COUNTY

- 16 MA U.S. No. 10 (166,222, 179, 44, 82, 165, 201, 51, 177, 169)
- 16 MB Madison County Line via Hegben Lake to 16 MJ.
- 16 MC U.S. No. 191 (Targhee-West Yellowstone)
- 16 MJ Bozeman-West Yellowstone (203, 209, 76, Forest)
- 16 MY Manhattan-South (41)
- 16 MZ Belgrade-Maudlow (40)

GARFIELD COUNTY

- 17 MA Central Montana Highway (256-E)
- 17 MB Jordan-Miles City (157-B, 157-C, 157-E)

GLACIER COUNTY

- 18 MA U.S. No. 2 (147, 220-A,B, 196, 260, 226, Forest)
- 18 MB U.S. No.87 North of Browning Wye (208,210,227) Not under state maint.
- 18 MC U.S. No.87 South of Browning (190)



GOLDEN VALLEY COUNTY

19 MA Musselshell County to Wheatland County (115-B,C)

GRANITE COUNTY

20 MA U.S. No. 10, (92, 184-A,B,C,D)  
20 MB Drummond-Philipsburg-Deer Lodge. (205, 78, 175, 164-B)  
20 MI Skalkaho Highway (Forest Section)

HILL COUNTY

21 MA U.S. No. 2 (95, 132-A,B)  
21 MB Havre-Port Benton-Great Falls (252-A,B)

JEFFERSON COUNTY

22 MA U.S. No. 91 (178, 242)  
22 MB U.S. No. 10-S (248, 69)  
4 MA U.S. No. 10-N  
29 MA Lyon-Ennis-Harrison-Sappington (171-D)

JUDITH BASIN COUNTY

23 MA U.S. No. 87-E (235-A,D,E,F, }

LAKE COUNTY

24 MA U.S. No. 93 (191-A,B,C,D, 93, 65, 200, 194, 192)  
45 MA Clark's Fork-Ravalli West.

LEWIS & CLARK COUNTY

25 MA U.S. No. 91, Helena-North (172-A,D)  
22 MA U.S. No. 91, Helena-South  
25 MB U.S. No. 10-U, (77-A,B,C, 249-C, Forest)  
25 MC Cascade County Line via Augusta to Powell Co. Line except 238-D)  
25 MD Teton County Line via Augusta to U.S. No. 91 at Wolf Creek. (238-A,B  
C,D.)

LIBERTY COUNTY

26 MA U.S. No. 2 (62-B,C, 132-C)

LINCOLN COUNTY

27 MA U.S. No. 2 (58-C, 250-A, Forest.)  
27 MB U.S. No. 93 (263, Forest)  
27 MC Eureka-Rexford-Jennings-Libby (137, 145-A,D, 118, Forest)

MC CONE COUNTY

28 MA Dawson County Line via Circle to Garfield County Line.  
28 MB Circle to Roosevelt County Line.

MADISON COUNTY

- 29 MA Gallatin County Line via Hegben, Lyon, Ennis, Norris to Jefferson  
County Line (171, 244, Forest)  
1 MA U.S. No. 91 (241-B)  
29 ML Ennis-Ruby (9-A,B)

MEAGHER COUNTY

- 30 MA U.S. No. 87-W (239-B,D,E,F, 8 , 94, Forest)  
30 MB Townsend-White Sulphur Springs-Harlowton, except 8, 239-D,F.  
30 MI White Sulphur Springs to Broadwater County near Watson (49)

MINERAL COUNTY

- 31 MA U.S. No. 10 (183, 254, 233, Forest)

MISSOULA COUNTY

- 32 MA U.S. No. 10 (131-A,B, 206, 231, 141, 29, Forest)  
32 MB U.S. No. 93 (215, 219)  
32 MC Powell County Line to Bonner (237-A)

MUSSELSHELL COUNTY

- 33 MA U.S. No. 87-E (108, 33, 91, 138)  
33 MB Golden Valley County Line to Rosebud County Line.

PARK COUNTY

- 34 MA U.S. No. 10 (185, 117-A)  
34 MB U.S. No. 87-W (217, 59, 14, 13, 105, 60, 239-A,B,C, Forest)

PETROLEUM COUNTY

- 35 MA Central Montana Highway (256-A,B,D,E)  
14 MA U.S. No. 87-W (28)

PHILLIPS COUNTY

- 36 MA U.S. No. 2 (153-B, 153-A, 152, 142)

PONDERA COUNTY

- 37 MA Shelby-Conrad-Vaughn (67)  
37 MB U.S. No. 87 (236-A,B, 190)

POWDER RIVER COUNTY

- 38 MA Alzada-Broadus-Miles City (198, 156-C, 162-A,B)

POWELL COUNTY

- 39 MA U.S. No. 10-S and U.S. No. 10 (184-D,E, 261-A)
- 39 MB U.S. No. 10-N (249-A,B)
- 39 MC Lewis and Clark County Line via Ovando to Missoula County.

PRAIRIE COUNTY

- 40 MA U.S. No. 10 (130-B,C, 158-C)

RAVALLI COUNTY

- 41 MA U.S. No. 93 (Gibbons Pass, 139, 174, 39, 259, 215-E)
- 41 MI Skalkaho Highway (161)

RICHLAND COUNTY

- 42 MA North Dakota Line via Sidney to Dawson County Line (245-A,B)
- 42 MB North Dakota Line via Sidney to Roosevelt County Line (265-C)

ROOSEVELT COUNTY

- 43 MA U.S. No. 2 (84, 240, 253)
- 43 MB Culbertson-Plentywood (193-A,C,E)
- 43 MC Macon Bridge to Daniels County Line (266-A,B)

ROSEBUD COUNTY

- 44 MA U.S. No. 10 (114, 15, 135-A,C,B)
- 44 MB Forsyth to Musselshell County Line.
- 9 MB Jordan-Miles City (157-A,D)
- 44 MJ Forsyth-Lame Deer (16)

SANDERS COUNTY

- 45 MA Montana No. 3 (197, 88, 186, 223, 202, 90, 150, Forest)

SHERIDAN COUNTY

- 46 MA Scobey-Culbertson-Plentywood (193-B,D,E)
- 46 MB Plentywood to North Dakota Line.

SILVER BOW COUNTY

- 47 MA U.S. No. 10-S (159, 207, 70)
- 47 MC U.S. No. 91 South of Nissler (241-C)

STILLWATER COUNTY

- 48 MA U.S. No. 10 (170-B,C, 109, 123)
- 48 MI Columbus-Golden Valley County Line (129)

SWEET GRASS COUNTY

- 49 MA U.S. No. 10 (133, 127, 125, 117)



TETON COUNTY

50 MA U.S. No. 87 (151, 136, 65-A)  
50 MB Pondera County via Dutton to Great Falls (211-B)  
50 MC Choteau-Augusta.

TOOLE COUNTY

51 MA U.S. No. 2 ( 62-A, 154-A,B, 220-B)  
51 MB Canadian Line via Shelby to Pondera County Line (243, 67)

TREASURE COUNTY

52 MA U.S. No. 10 (160-D)

VALLEY COUNTY

53 MA U.S. No. 2 (232, 189, 144, 155, 148)  
53 MY F.A.P. 83

WHEATLAND COUNTY

54 MA Roundup-Harlowton-White Sulphur Springs (115-A,B, 8-D)

WIBAUX COUNTY

55 MA U.S. No. 10 (1, 35, 61)

YELLOWSTONE COUNTY

56 MA U.S. No. 10 (160-A,B,C, 53, 34, 230, 228, 57, 170-A)  
56 MB U.S. No. 87-E, North of U.S. No. 10 (108-C)  
56 MC U.S. No. 87-E, South of Billings (187-A,B,C,D)  
5 MA U.S. No. 310 (134)  
56 MY Polytechnic Road (52)

2.13                   The order number denotes the class of the work, and  
Order                   must always be used. These numbers are as follows:  
Numbers.

(a) GENERAL MAINTENANCE

1. All general maintenance items.

(b) SPECIAL MAINTENANCE

2. Resurfacing and filler.
3. Guard fence.
4. Snow removal.
5. Bridges.
6. Slides, washouts, drainage.
7. Oiling.
8. Pavement shoulders.

(c) BETTERMENTS.

These orders will run consecutively regardless of class of work; numbers starting with 10.

2.14

Code  
Numbers.

The code numbers are used to show the segregation of work into its various phases. These numbers are as follows:

(a) GENERAL OR SPECIAL MAINTENANCE.

Code No.

- 21 Rock or gravel surfacing.
- 22 Shoulders, ditches, weeds, brush & culverts.
- 23 Unsurfaced sections.
- 24 Slides and washouts.
- 25 Guard fence.
- 26 Snow removal.
- 27 Bridges.
- 28 Signs and signals.
- 29 Concrete pavement.
- 30 Bituminous pavements.
- 31 Rock or gravel shoulders of pavement.
- 32 Oiled surface maintenance.
- 33 Erection and removal of snow fence.
- 34 Equipment parts, overhaul, and repair.
- 35 General superintendence.

(b) BETTERMENTS.

- 41 Rock or gravel surfacing.
- 42 Grading including widening.
- 43 Culverts and drains.
- 44 Miscellaneous structures.
- 45 Guard fence.
- 46 Snow fence.
- 47 Bridges.
- 48 Signs and signals
- 49 Concrete paving.
- 50 Bituminous paving.
- 51 Rock or gravel shoulders to pavement.
- 52 Oiled surface betterments.
- 54 Equipment parts, overhaul & repair.
- 55 Superintendence - general.

NUMBER 21 is to cover the maintenance of the surface of rock or gravelled sections, and includes dragging, blading, scarifying, removing oversize, and in short all maintenance of the surface of the road.

NUMBER 22 includes all work outside the surface such as drainage, both ditches and culverts, and work around bridges. Also the removal of weeds and trash.



NUMBER 23 includes the cost of the maintenance of the travelled portion of sections which have not been surfaced.

NUMBER 24 should be used in connection with slides and washouts which require additional forces. Work done by the regular force will be charged out under No. 22.

NUMBER 25 includes painting, re-lining and all general maintenance on guard fence. The repair of guard fence injured by slides and washouts should be charged under No. 24, and small sections of guard fence continuous with bridge handrail should be charged to No. 27.

NUMBER 26 shall include snow removal only.

NUMBER 27 shall include all bridge repairs. Special section prefixes have been assigned to the larger bridges and will be used for larger jobs of maintenance such as re-decking, painting, bank protection, etc. Small jobs done by the regular force in connection with other daily work will be carried under 21 or 22 as the case may be.

NUMBER 28 covers maintenance and replacement of signs and signals.

NUMBERS 29 and 30 cover the surface of the pavement only. Other work on paved sections will be covered by No. 22, No. 24, No. 31, etc.

NUMBER 31 is self explanatory.

NUMBER 32 covers the maintenance of the surface of all types of oiled sections.

NUMBER 33 shall include work on snow fence and sloping cuts when such is done for the purpose of preventing drifts.

NUMBER 34 shall include the maintenance of all equipment. Labor on overhaul, repair parts, tires, etc., shall be included under this number. Gas, oil, and grease shall not be charged to this number but shall be charged to 21, 22, etc., as required.

NUMBER 35 shall cover the time of Maintenance Superintendents and shall not include foremen who shall segregate their time the same as the other laborers.

NUMBER 41 includes all work on resurfacing of old screened gravel sections which have not been surfaced under the 3/4 inch specification. Resurfacing of sections which were constructed under the new specifications would be special maintenance and chargeable to maintenance code No. 21.

NUMBER 42 shall not include widening where material is removed from a slide, but shall include special widening jobs done under contract or by extra gang.

NUMBER 43 shall include the replacement of wooden structures as a betterment. The replacement of metal on concrete culverts which have failed would be a general or special maintenance item, however, and would be charged under No. 22. A replacement of a small culvert which has proven too small by a large structure would be a betterment.

NUMBER 44 shall cover retaining walls, powder houses, pipe lines and drinking fountains, sand fences, and all miscellaneous structures.

NUMBERS 45, 46, 47, and 48 are self explanatory.

NUMBERS 49 and 50 shall include only additions and shall not include the repair of failures.

NUMBER 51 shall include only the placing of gravel shoulders where they have not been previously provided. Repair of existing gravel or rock shoulders would be carried as general or special maintenance under Code No. 31.

NUMBER 52 shall be only used upon special order as oiling in general is purely a maintenance and is covered under maintenance Code No. 32.

NUMBER 54 is self explanatory.

NUMBER 55 shall cover only the time of superintendents, and shall not include foremen's time.

2.15 To farther segregate cost data in connection with  
Code special maintenance, suffixes are added to code  
Suffixes number 21 (Rock or gravel surfacing) and code  
number 32 (Oiling). These suffixes are as follows:

CODE NO. 21 (ROCK AND GRAVEL SURFACING)

- a Purchase of quarries - Royalty.
- b Freight and setup.
- c Operation of pit or quarry.
- d Crushing.
- e Hauling and spreading.
- f Supervision
- g Road preparation.
- h Spreading and processing.
- n Application of binder.
- p Stock piling.
- x Equipment parts, overhaul & repair.
- y Operation of cook house.



NOTE: Should the surfacing operation be a betterment, Code No. 41 shall be used with the foregoing suffixes.

CODE NO. 32 (OILING)

- a Cost of oil, F.O.B. Refinery or Jobber.
- b Freight and demurrage.
- c Application and heating.
- d Addition of rock screenings or squeegee & mixing.
- e Transfer of equipment, plant setup.
- f Preparation of macadam.
- g Flagmen, protection of traffic.
- h Cost of screenings.
- i Supervision.
- x Equipment parts, overhaul, and repair.

NOTE: Should the oiling operation be a betterment Code No. 52 shall be used with the above suffixes.

2.16 In writing a charge, use first the Section Prefix, as  
Maintenance "43 MA", followed by the Order Number, as "2", followed  
Coding by the Code Number, as 21. This will be written 43 MA-2-  
21 and represents the placing of binder as a special maintenance under Order  
No. 2 on the Roosevelt Highway in Roosevelt County. 43 MA-2-21d would represent the crushing of rock or gravel under special maintenance order No. 2 on the above mentioned section. The Section Prefix, Order Number, and Code Number must appear in every instance, except in the case of general maintenance when the order number "1" may be omitted, as 23 MA-22 would be understood to mean 23 MA-1-22. Suffixes shall be used on all coding in connection with special maintenance or betterment orders covering surfacing and oiling. All maintenance charges, general or special, take code numbers 21 to 35; all betterments take code numbers 41 to 55.

2.17 An M 20 holding account is assigned to Division and  
M 20 Resident Engineers and Maintenance Superintendents as  
Holding a matter of convenience in coding and distributing super-  
Account.

vision charges in connection with maintenance operations which cannot be readily and accurately charged to Code 35 or 55. At the close of the fiscal year these M 20 charges are pro-rated and charged back against the maintenance allotments under the jurisdiction of the person making the charge. In order that the accounting department may enter the charges against the right account, it is necessary in all cases that the initials of the Engineer or Maintenance Superintendent to whom the charge belongs immediately follow the M 20 and be supplemented by one of the following code numbers:

- 01        Salaries only.
- 02        Railway and other transportation and personal expenses including board, room, railway transportation requests or mileage, pullman accommodations, auto, team, and saddle horse hire.
- 03        Automobile supplies and repairs.
- 04        Miscellaneous personal supplies, and services paid personally - includes postage, telephone, telegraph, etc.

For example: John Doe's payroll distribution shall show M 20-JD-01; purchase of gasoline for his car, M 20-JD-03, Etc.

All Engineers and Maintenance Superintendents shall be especially watchful that this account is not made a "dumping ground" for miscellaneous charges.

2.18                      As a matter of convenience, jobs and classes of  
Miscellaneous              expenditures, instead of being referred to by names  
Coding.                      are designated by numbers. The numbers used to  
designate jobs are called "job prefixes" and they usually consist of the  
Federal Aid Project number, and unit for construction, preconstruction, and  
right of way account, written thus: 160-D, Unit 2, C 17-01 for participat-  
ing construction engineering salaries (Page 11 - Account Code). 160-D,



Unit 1, CFA 19-01 for common excavation and borrow done by state forces (Page 9 - Code 19). Work performed by contractor's forces, pole moving, etc., use code No. 18 ( Page 9 Account Code) . F.A.P. 211-A, Unit 1, PC 11, etc. for preconstruction ( Page 10 Account Code). 149-E, RW 1501 etc. for right of way claims (Page 13 Account Code). Signing (Page 14-A & B Account Code). Administrative ( 1, 3, and 4 Account Code. These codes shall only be used by the Maintenance Department upon specific instructions from headquarters.

2.19                      Distribution shall be shown on the face of the original  
Coding                      and duplicate invoices and claims in a legible and  
Claims                      orderly manner. If there is not sufficient space on the  
face of the invoices or claims, distribution shall be shown on the back by  
turning the bill or claim in tumble form. In no case shall the distribution  
be shown on the short form jurat. The arrangement of the coding shall at all  
times be grouped according to (1) Administration, (2) Preconstruction, (3)  
Construction, (4) Construction Force Account, (5) Right of Way, (6) M 20-  
Maintenance Supervision, (7) Maintenance. Under these captions, the charges  
shall appear in numerical order. The following example will illustrate the  
correct form of coding:

A 11-03	1.50
A 11-04	.45
149-E, Unit 1, PC 11-03	3.00
252-C                      PC 11-04	3.25
132-E, Unit 2, C 16-03	4.65
132-E, Unit 2, C 17-03	6.55
132-E, Unit 2, C 17-04	5.20
235-D, Unit 4, CFA 1912	4.45
236-B, Unit 4, CFA 1932-a	5.55
236-B, Unit 4, CFA 1932-f	3.67
252-C                      RW 15-03	8.32
M 20-JD-03	16.55
3 MA-21	3.56
3 MA-25	25.66
3 MA-2-21d	9.65
3 MA-7-32c	16.55
3 MA-10-47	21.66
3 MA-11-52d	1.55
50 MA-22	2.44
	<hr/>
	144.21

The total of the distribution must in all cases agree with the total of the claim and purchase orders.

2.20 (e) PURCHASES. With the exception of emergency purchases, all purchases are to be made through the general. State Purchasing Agent on requisition or from dealers authorized by the State Purchasing Agent. All materials, supplies, etc., need of which can be anticipated, shall be requisitioned. On small purchases, which will probably be made locally, dealers' bids should be submitted with the requisition. Gravel or rock for surfacing shall be requisitioned, giving name of owner of pit, price, and approximate yardage to be used. The authorized dealers are to furnish materials and supplies on a monthly basis, purchases to be confirmed at the close of the month by the State Purchasing Agent. At the time purchases are made from authorized dealers a field purchase order (No 2a) shall be given. At the close of the month a bill shall be submitted by the dealer, invoiced in triplicate, with jurats in duplicate, accompanied by the original emergency field purchase orders (No. 2a). This bill shall be checked and approved in the Division Office, yellow copies of Emergency Field Purchase Orders attached, and a request made on Form 76 that the purchases be confirmed. This requisition (Form 76) should show the first and last dates appearing on the invoice with a notation requesting that the purchases on the attached claim be confirmed and should be forwarded to headquarters for further attention. The Equipment Department will list the items covered by the invoice on the Purchasing Department's confirmation requisition form, assigning a purchase order number to the confirmation requisition. A copy of this requisition will be returned together with the duplicate of the requisition (Form 76)



to the Division Office. This procedure will eliminate the necessity of itemizing requisitions in the field and the delay in clearing this class of claims for payment. Where a requisition covers a request for supplies to be purchased, the duplicate of Form 76 will be returned to the Division Office with the number of the requisition submitted to the Purchasing Department. When the purchase order has been issued the yellow or quadruplicate copy will be mailed direct to source of the requisition. In submitting claims covering purchases of this nature the District Office will attach this yellow copy of the purchase order to the invoice in triplicate and jurat in duplicate before sending to Division Offices where the yellow copy of the purchase order may be retained for their files after the claim has been checked and approved.

2.21                      Contracts for supplying gas, oil, and grease are let  
Purchase of                      by the State Purchasing Agent for six month periods.  
gas, oil, grease.                      Upon a request from headquarters, the Division Engineers  
shall furnish a list of dealers in the respective towns in their divisions who are capable of supplying the necessary service. In cases where a contract is given and the service is not satisfactory, Division Engineers will promptly report to headquarters, in detail, giving the reasons why the dealer is not giving satisfactory service. Headquarters Office will then request the State Purchasing Agent to cancel the contract and enter into a new contract with another dealer. In cases where gas, oil, and grease cannot be obtained from the contract dealer, due to the fact that his place of business is closed or he is out of stock, purchases may be made from dealers who have no contract on emergency field purchase orders, making a notation in the remark column or on the back thereof, showing the reason for the pur-

chase. For instance, "Contract Station Closed". An emergency field purchase order must be issued for all purchases of gas, oil, and grease, regardless of the fact that the purchase is covered by a state purchase order contract.

2.22                      Emergency field purchases are to be made when a  
Emergency                      delay in securing supplies or parts through the  
Purchases.                      Purchasing Agent or his authorized dealers would  
result in loss of time of employees and laying up of equipment or in-  
curring loss to the Department. The purchases shall be made on an  
emergency field purchase order at the best price obtainable, and the  
purchase shall not be confirmed. Emergency field purchase orders shall  
be issued in all cases of emergency purchases at the time of the purchase.  
The practice of writing up emergency field purchase orders when the bill  
covering monthly purchases is received will not be tolerated. Division  
Engineers shall be held responsible for all emergency field purchase  
order books and they should be issued to no one but responsible employees.  
Emergency field purchase orders must be signed by the person making the  
purchase, and show the details of the purchase, account, code and equip-  
ment number.

2.23                      (f) CLAIMS. All claims against this department  
Claims                      for personal expense, labor to be paid from the  
General                      revolving fund, freight, express, telephone and  
telegraph, shall be made in duplicate on Form 23. These claims need not  
be covered by purchase orders. All other claims for materials and  
supplies shall consist of three copies of the vendor's invoice with  
jurats in duplicate and necessary purchase orders, this includes



emergency purchases as well as all purchases made or confirmed by the State Purchasing Agent.

2.24                      When the vendor holds a contract for the delivery of  
Claims                      gasoline, and purchases are made of gas, storage, etc.,  
Gas & Oil.                      not included in his contract, he shall include these items  
in his claim covering gas, in the same manner as if covered by the contract.  
It is not necessary to issue separate emergency field purchase orders for  
the miscellaneous items except as noted in the following paragraph.

When the vendor is acting as an agent for a manufacturer of gasoline and he delivers oil, storage, etc., for his own account, a separate claim shall be submitted for the gas in the name of the manufacturer having the contract, with emergency field purchase orders attached, and a claim shall be submitted in his own name for oil, storage, etc., with emergency field purchase orders attached. This claim shall be approved in the regular manner and forwarded to headquarters with request for confirmation. In this case it will be necessary to issue separate emergency field purchase orders. The reason for this is readily apparent when one understands that when we buy from a manufacturer, the State Highway Commission is exempt from paying the Federal Gas Tax, and when purchases are made from other than a manufacturer, the tax must be paid.

2.25                      Field men shall be responsible for the prompt submission  
Submission                      of claims. Assistance may be given to vendors when needed, but it shall not be the policy of the department to prepare claims for the vendor. All claims shall be submitted through the Division Office where they shall be checked in every detail, and approved, before submitting to headquarters.

## CHAPTER III

### EQUIPMENT DEPARTMENT

#### 1. ORGANIZATION

3.1                   (a) GENERAL. The Equipment Department has charge Headquarters. of procuring, maintaining and disposing of motor vehicles and all major equipment, and the designing and construction of specialized equipment used by the Highway Commission. This Department is under the direct charge of the Equipment Superintendent, who is the representative of the Maintenance Engineer in matters pertaining to equipment, shops, stores, etc.

3.2                   Division shops are located at the Division head- Division quarters and are in direct charge of a Division Shops. Mechanic, who is responsible for the upkeep of the equipment within the territory assigned to him by the Division Engineer.

3.3                   District shops are maintained in addition to the District division shops wherever necessary. District shops Shops. are under the direct supervision of a District Mechanic, and he is responsible for the upkeep of the equipment within the territory assigned to him by the Division Engineer.

3.4                   (b) DUTIES. The Equipment Superintendent exer- Equipment cises general supervision over all equipment Superintendent. purchases and disposals, purchases of repair parts, stores, etc., and the construction and maintenance of shop facilities. The Equipment Superintendent is available for consultation with the field men at any time that he can be of any assistance or service to



them. Requests of this nature shall be transmitted through the Division Offices and approved by the Maintenance Engineer.

3.5                      The Master Mechanic is the headquarters assistant to the Equipment Superintendent, and is in direct charge during the absence of the Equipment Superintendent.

Master Mechanic

He is responsible to the Equipment Superintendent for all headquarters shop activities and personally supervises all major and special overhauls, and the design and construction of special equipment undertaken by the headquarters shop. The Master Mechanic is subject to call at all times by the Field men when he can be of any service or assistance to them in matters pertaining to major overhauls or in altering the design of equipment. Requests for his assistance shall be submitted through the Division Office to headquarters for the approval of the Maintenance Engineer and the Equipment Superintendent.

3.6                      The Equipment Clerk is an assistant to the Equipment Superintendent in all matters pertaining to equipment records, costs, and accounting, and is Acting Equipment Superintendent in the absence of both the Equipment Superintendent and the Master Mechanic. He is responsible for the headquarters' stocks and stock room as well as the field stores accounting, and all records, files and accounting pertaining to motor vehicles and major equipment.

Equipment Clerk

3.7                      The Division Mechanic is directly responsible for all overhaul work done within the Division Shop and is to make periodical inspection trips during the operating season to determine the condition of the equipment within his jurisdiction and to ascertain if repairs are necessary. At the discretion of the Division

Division Mechanic.



Engineer or the Equipment Superintendent, he may be required to assist District Mechanics in special work. The Division Mechanic shall report to and through the Division Engineer.

3.8                      The District Mechanic is responsible for the over-haul and upkeep of all equipment within his territory, and shall make periodic inspections of the equipment during the working season. The District Mechanic shall report to and through the Resident Engineer or the Maintenance Superintendent, who in turn shall report to the Division Engineer.

## 2. GENERAL DETAILS.

3.9                      The value to the State of any machine or piece of equipment depends on how it is operated and cared for in service. The amount and cost of maintenance on road machinery depends primarily on the kind of work to which it is assigned and the conditions under which it is operated. These conditions are greatly influenced by the supervising and operating personnel. They are responsible for what might be called preventive maintenance. Those who are responsible for the placing of the equipment in the field should give considerable thought to whether the equipment is fitted to perform the work to which it is assigned. For instance it is undesirable to place a motor patrol, regardless of make, on ditching or shouldering up operations. This type of equipment is designed for surface work, and in order that upkeep may be kept at a minimum, it must not be used in operations to which it is unsuited.

3.10                     It is not necessary to stock supplies outside of current needs in any District Shop. The location of some of the Division Shops makes it advisable to carry a limited stock of parts and supplies which have been charged out.

However, stocks of this kind must be limited to standard materials of common usage, and on which expensive delay would ensue if they were not available in stock. No stock will be carried in a stores account without permission and a "set up" from the Accounting Department. The only stores accounts at present are grader blades, culvert pipe and gasoline. It is required that each shop, whether District or Division, employ a "want book" to list their anticipated requirements for stock and that requisition for same be submitted at regular periods in place of submitting a requisition for a dozen files to-day, five pounds of solder to-morrow, etc.

All small tools, such as shovels, picks, fresnos, etc., required for a season's maintenance work, shall be estimated when requested by the Equipment Superintendent. When these tools are received at the designated shops, they shall be charged out immediately, and are not to be placed in a stores account.

3.11                      Equipment shall never be borrowed from any source until  
Borrowing of              permission has been secured from headquarters. Breakage  
Equipment.                or an accident with borrowed equipment often proves very  
costly. Under no circumstances shall any state owned tools or equipment be  
loaned or rented to any private persons or concerns.

3.12                      No equipment shall be rented for State use until author-  
Rental of                ity is secured from headquarters, and then a very definite  
Equipment.               agreement in writing shall be made with reference to  
repairs, supplies, rate of rental etc. Requests for rental of state owned  
equipment shall be referred to headquarters for approval before entering into  
any agreement.

3.13

Rental  
Schedule.

The following rental schedule shall be used whenever state owned equipment is used on construction force account work:

<u>CARS</u>	<u>RATES PER DAY</u>
Fords and Chevrolets	\$1.00
All Others	1.50

<u>TRUCKS</u>	
Fords, Chevrolets, and Internationals 1½ Ton or less	1.50
All Two Ton	3.00
All 3½ Ton	5.00
All 5 Ton	7.50
Five Ton with Ciler	15.00
Five Ton with Booster	10.00

<u>TRACTORS</u>	
20 Cletrac - 2 Ton & 20 Holt	2.00
30 and 5 Ton Holt	4.00
60 Holt and upwards	6.00

<u>GRADERS</u>	
Team	0.30
8 to 10 foot	1.50
12 foot	2.00
Motor Patrols with power	4.00

<u>MISCELLANEOUS</u>	
Killifer Road Disc	3.00
Killifer Scarifier	1.00
Compressor	2.50
Portable Boiler	3.00
Portable Retort	3.00
Road Brooms (not powered)	1.00
Road Brooms (powered)	4.00
Belt Loaders (powered)	2.50
Drags (Adams #6)	1.00
Drags (wood)	0.50
Scarifier Graders	2.00

<u>SNOW PLOWS</u>	
Rotary Snow King (small & medium)	4.00
Rotary Snow King (large)	8.00
V Type Plows	1.50
Mouldboard Type Plows	1.00



3.14                      No equipment will be tried out except upon a strict understanding that the State is in no way obligated, and then only after an understanding with headquarters and through them with the State Purchasing Agent. A trial generally carries an obligation to purchase if the trial is acceptable, and furthermore the danger of an accident is always present.

New Equipment  
for Trial.

3.15                      No equipment, parts or material owned by the State Highway Commission may be sold to its employees. When it is necessary to dispose of major equipment, the "Unserviceable Equipment Report" form shall be filled out and submitted to headquarters for approval before salvage is started. The State Highway Commission does not dispose of any of its discarded equipment through sale. Usually salvage that is secured from discarded equipment is of more value to the Department than any price it would be possible to secure for it. Discarded repairs and parts such as tires, pistons, cylinder blocks, connecting rods, etc., which have been condemned shall be destroyed immediately. Under no circumstances are these to be given away or sold regardless of how worthy or extenuating the case may be.

Disposal of  
Equipment.

### 3. SHOP INSTRUCTIONS.

3.16                      All shop employees shall be experienced, capable and honest, so that throughout their dealings with the field forces they may merit confidence and respect. Shop employees shall always be courteous and friendly. When employees suitable for shop work are unobtainable in a division, transfer of them from another division may be arranged for through headquarters.

Personnel  
Qualifications.

3.17 All shop employees shall be on duty from 8 A.M. to  
Working 12 A.M. and 1 P.M. to 5 P.M. except in special  
Hours. cases. During working hours, gossiping, loafing,  
or visiting with outsiders shall not be permitted and will not be tolerated.  
Tool salesmen or others will not be permitted to do any canvassing of the  
employees except during the noon hour and before 8 A.M. or after 5 P.M.  
All shop employees will travel to and from work on their own time.

3.18 No work whatever shall be done on any privately  
State Property owned equipment at any state shop. The buildings  
for Private and other facilities at the various shops are  
Use. State property and are to be occupied and used  
only in the interest of the State. The loaning of shop tools or any  
other State property, either to employees or to outside parties, is for-  
bidden.

3.19 All buildings must be maintained in good repair,  
Maintaining of both inside and out. All dirt or rubbish must be  
Buildings, Yards, cleaned up regularly and burned to prevent a fire  
and Tool Equipment. hazard. The yards must be kept clean and all  
equipment stored in them, arranged in an orderly manner. Tool equipment  
must be properly protected and cared for. No abuse of tools will be toler-  
ated.

3.20 (a) NEW EQUIPMENT. A new piece of motorized  
Equipment equipment shall be taken to the nearest State  
Servicing. shop, where it shall be serviced and checked  
over before assigning it to duty. When new equipment is received, a  
report of the serial and motor number shall be made immediately to head-

quarters, so that an equipment number may be assigned and license plates secured if necessary. The standard insignia shall be placed on the left front door of all cars and trucks and on the left hand side of other equipment in a suitable location along with the equipment number assigned to the particular unit. This rule is void in some cases where special permission has been secured from headquarters. The identification target shall be placed on all cars and trucks immediately and maintained at all times. This target is to be attached to the front license plate holder or cross bar on the left hand side of the unit. A fire extinguisher shall be mounted in each new car or truck as soon as received.

(b) USED EQUIPMENT. When equipment is brought to the shop for service and repair, inspection shall be made of not only the parts upon which service is requested, but also all others if time permits. The following should be inspected on all motorized equipment whenever the shop employees have a chance:

1. Inspect the oil level and the condition of the oil.
2. Check radiator for cooling level liquid and leaks.  
If anti-freeze is being used, check protection to 20° below zero or the temperature requested.
3. Check gasoline supply.
4. Check brakes.
5. Check tire pressure.
6. Check steering gear.
7. Check transmission and rear end for the proper oil level.
8. Grease car if needed.
9. Inspect the battery for liquid level and corrosion.
10. Inspect the horn.
11. Check the lights - head light, tail light, and stop light.



12. Inspect the ignition and light wiring.
13. Check fire extinguisher.
14. Wash car if needed.

3.21

Recommended  
SAE Weights  
of Oil.

The following oil recommendations are made for convenience in servicing equipment. Variation from these recommendations may be necessary for various reasons.

Car Recommended S.A.E. Weights of Oil

	<u>Winter</u>	<u>Summer</u>
Buick	30	40
Chevrolet	30	40
Chrysler	30	40
De Soto	30	40
Dodge	30	40
Ford	30	40
Nash	30	40
Pontiac	30	40
Studebaker	30	40
Willys Knight	30	40

Trucks

Chevrolet	30	40
Coleman	40	50
Ford	30	40
G.M.C.	30	50
F.W.D. Truck M-5	40	60
F.W.D. Other Models	40	50
International	30	50
Pontiac	30	40
Reo Speed Wagon	30	50
Whippet	30	40

Tractors

Allis-Chalmers	40	60
Case 26-40	40	60
Cletrac K-20	30	50
Holt 2-Ton	40	60
Holt "20"	30	50
Holt "30"	30	50
Holt "60"	40	80
McCormick-Deering	40	60

3.22

Six ply passenger car tires from 4.50 x 21 to 5.50 x 20

Recommended

in size should be inflated to thirty-five pounds.

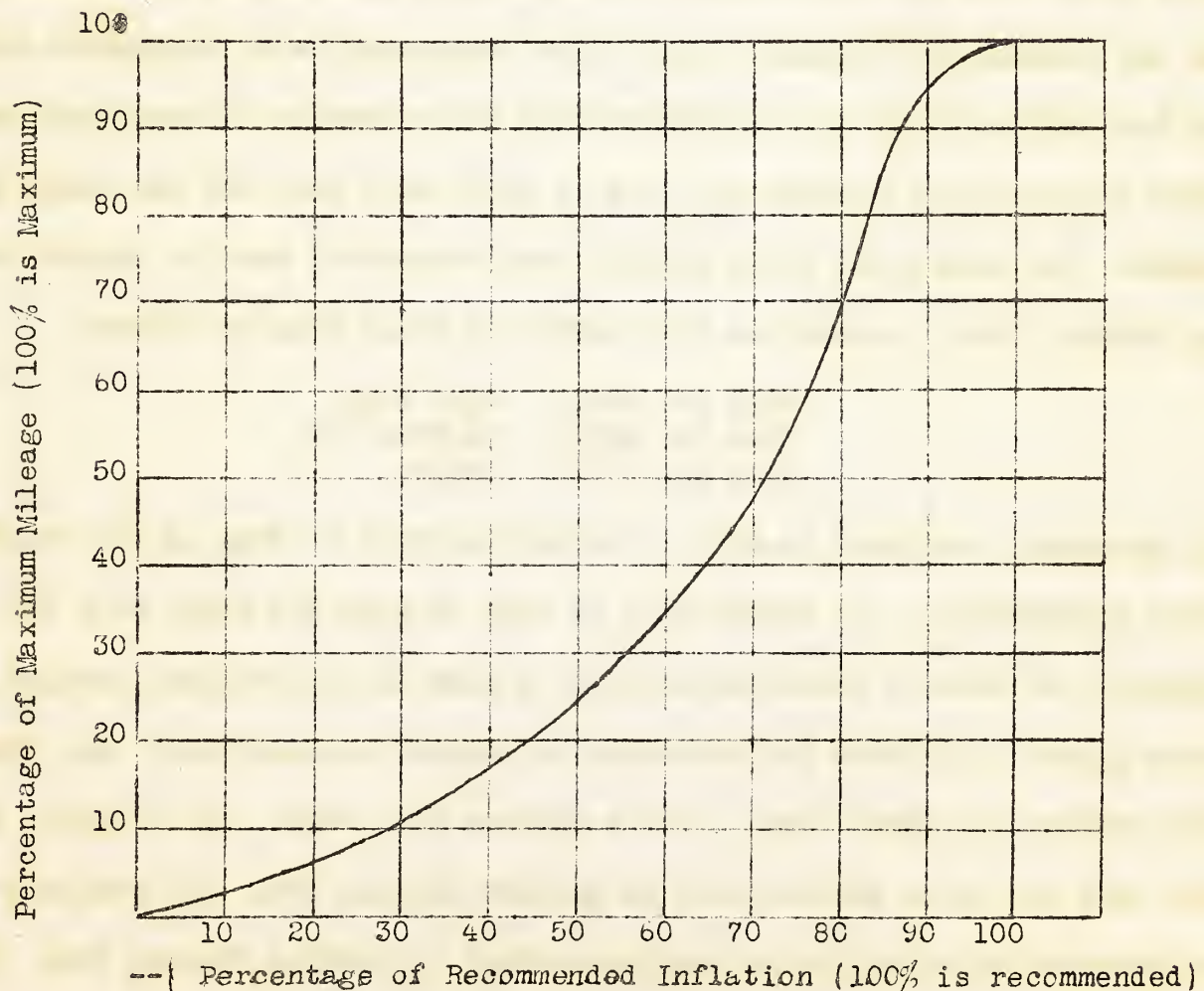
Tire Pressure.

Truck Balloon Tire Pressures

7.50 x 20	Eight Ply Tires	55#
7.50 x 24	Eight Ply Tires	55#
8.25 x 20	Ten Ply Tires	60#
9.75 x 24	Twelve Ply Tires	70#
10.50 x 20	Twelve Ply Tires	75#

Truck and Grader High Pressure Tires

30 x 5	Eight Ply Tires	75#
32 x 6	Ten Ply Tires	80#
36 x 6	Ten Ply Tires	90#
34 x 7	Ten Ply Tires	100#
40 x 8	Twelve Ply Tires	110#
38 x 9	Twelve Ply Tires	120#
44 x 10	Sixteen Ply Tires	130#



There is one correct inflation for every condition of service, and to secure from a tire the maximum mileage that has been built into it, it is necessary to maintain at all times the exact recommended air pressure. As an example, if a 36 x 6 H.D. rated for an inflation of 90 lbs. air pressure, is operated at 63 lbs. pressure, the tire is being operated at only 70% inflation. Referring to the above chart, it will be seen that a tire operated at 70% recommended inflation or 30% under-inflation, will deliver but 48% normal service.

3.23 (a) EQUIPMENT. Before painting, clean the old surface thoroughly, being careful to remove all oil and grease. Sand off rust spots and very rough places. Prime where rust has been removed or where bare metal shows with white lead and raw linseed oil thinned to the right consistency with turpentine and let dry for twelve hours. All equipment with the exception of passenger cars and light trucks should receive one coat of paint each year and two coats if needed. The paints now being used by this Department are the product of the General Paint Corporation sold under the trade name of "Flex."

Flex No. 2603	Ojai Gray
Flex No. A9713	Highway Red
Flex No. 2603	Black

All passenger cars when in need of repainting will be done in the original color combination. All trucks will be done in gray and black with the exception of Station Busses which will be done in the original varnish and black paint. All house trailers will be painted in Ojai Gray. All tractors, both crawler and wheel type, will be painted Ojai Gray. All graders, both pull type and motor patrols will be painted Highway Red. All trailers used in transporting materials or equipment shall be painted Highway Red. It is required, as a safety measure, that the tail gate and front bumper on all trucks be outlined in Highway Red paint. Boilers, retorts, oil



distributors and booster tanks will be painted with black asphaltum paint.

(b) BUILDINGS. All timber or frame buildings, floors, and wood-work, either painted or varnished, shall be kept in first class condition by painting or varnishing when necessary in the original colors. All metal buildings shall be painted with gray Portland Cement paint and maintained in first class condition by repainting when necessary.

3.24

(a) GENERAL. When a passenger car is brought into a Shop Practice. shop to be worked on whether it be for a minor adjustment or major overhaul, take precautions to protect the cushions from being soiled and the fenders from being scratched. Be sure the car will not soil the driver's clothes when it is turned back to him; that is, do not leave a dirty steering wheel, a greasy gear shifting lever, etc. Be as clean as possible when making repairs. Do not install parts before they are thoroughly washed.

When working on equipment and breakage or needed repairs which have not been reported are found, do not neglect them, but call the shop foreman's attention to them.

Do not turn out work that is not the very best, as the maximum is expected from the equipment, and it cannot be secured if repair work is slighted.

All shops are equipped with modern tools and appliances (limited in one or two cases) and they should speedily and economically turn out the average repairs. Work of unusual nature, beyond the capacity of the field shops, can be handled at the headquarters shop. All work shall be done in State shops where possible and shop equipment permits.

Headquarters, in nearly all cases, is able to furnish reconditioned motors for Ford cars and trucks and re-ground cylinder blocks

with pistons fitted for F.W.D. trucks with no delay. Be sure motor numbers check with equipment records when an overhauled motor is installed in a truck or car.

(b) MOTOR OVERHAULING. Standard clearance allowance for gray iron piston skirts is .00075" (three-quarter thousandth) per inch of piston diameter for passenger car motors. Applied to different piston diameters, clearances are as follows:

$2\frac{1}{2}$ " piston allow .002" clearance  
3 " piston allow .0025" clearance  
 $3\frac{1}{2}$ " piston allow .003" clearance.  
4 " piston allow .0035" clearance

Use a clearance of .001" per inch of piston diameter on pistons of motors subject to heavy duty, such as trucks and tractors, unless their motors are thoroughly run-in. Applied to a 4" diameter truck piston clearance allowance is .004".

Upper piston lands (sections above and between rings) must have additional clearance. Top land should have .0035" clearance per inch of piston diameter, second land .003" per inch, and the third land .002" per inch of diameter. Unless this clearance is allowed, extreme heating may cause piston head to seize and pull off. In fitting aluminum or alloy pistons, piston maker's instructions must be followed.

Aluminum alloy split skirt piston clearance is the same as for cast iron pistons, except where special clearance is specified by the maker.

When split skirt pistons are used it is important that the split be installed on the driver's side of the motor, as this is the side of minimum thrust.

Cylinder bores must be refinished to within one-thousandth of an inch (.001") for round and straight. This means half a thousandth (.0005") plus or minus a given size. Connecting rods and pistons must be in perfect alignment - at absolute right angles with crankshaft and cylinder. Always use a connecting rod and piston aligner.

Allow .0005" to .00075" (one-half to three-quarter thousandth inch) clearance for oil film when fitting piston pins to reamed holes. Pins bearing in cast-iron pistons should have no "drag", but should turn almost free. Oil thoroughly before assembling.

Do not assemble main and crankpin bearings tight to shaft, but in fitting, allow .001" clearance for each inch of pin diameter. End play on main bearings shall be .004" to .005" for regular sized motors and about .010 on big trucks and tractors.

#### Piston Ring Gaps

Cylinder Bore	Gap	Cylinder Bore	Gap
2-3/4 - 2-7/8	.015	3-7/8 - 4	.021
2-15/16 - 3-1/16	.016	4-1/16 - 4-3/16	.022
3-1/8 - 3-1/4	.017	4-1/4 - 4-3/8	.023
3-5/16 - 3-7/16	.018	4-7/16 - 4-9/16	.024
3-1/2 - 3-5/8	.019	4-5/8 - 4-3/4	.025
3-11/16 - 3-13/16	.020	4-3/16 - 4-15/16	.026

When installing new valve seats in a motor block, be sure to use the proper size ring. Use a ring that has an inside diameter that is the same as the valve port. Use a standard size seat ring as recommended by the manufacturer whenever possible. Use the correct size pilot stem and select the cutter having the same number stamped on it as the ring has that is to be installed. Be sure the cutter is fully inserted in the shank, and securely fastened before starting work. The recess for the ring must be concentric with the valve guide and deep enough, so that the top of the ring is flush with the top of the block or cylinder head.



Valve tappet clearances should agree with the manufacturer's recommendations.

3.24                      Steering gears, transmissions, differentials, body  
Manufacturer's           hoists and pumps, brakes, etc., should be "set  
Instructions              up" according to the manufacturer's instructions  
& Recommendations.      and recommendations.

3.25                      When bearings, connecting rods, and over-size  
Salvage                   pistons are in such shape that they may be re-  
of Parts.                  claimed for further use, they shall be saved, and  
when an appreciable quantity is collected, sent to headquarters.

3.26                      All special tools are to be furnished by the  
Shop Tools.               State. Each mechanic shall furnish all tools  
necessary outside of special tools to take care of  
the work to which he is assigned.

#### 4. OPERATING INSTRUCTIONS.

3.27                      The realization of a satisfactory investment in  
General                   State equipment depends on the care and attention  
Operating                which the equipment receives. Every operating em-  
Instruction.              ployee shall aid in making the investment profitable.

Because of the varied character of equipment owned by the State Highway Commission, general instructions will apply to all units not mentioned in specific instructions.

At all times, all working parts shall be kept clean and well greased with the proper lubricants and correctly tightened.

Equipment in need of repair must not be used until after repairs have been made, if such use will materially increase

the cost or repair.

All motor vehicles owned by the State Highway Commission and furnished employees are for use on State business only, and must not be used for private purposes. No persons other than employees shall be allowed to ride in or on maintenance equipment.

When a car or light truck is assigned to an employee for any length of time, arrangements must be made for shelter and necessary precautions taken to protect it from theft or other acts of vandalism.

Batteries and tires shall be inspected at regular intervals.

Practically all motorized equipment is furnished with an air cleaner of some type. These air cleaners shall be regularly inspected and cleaned. If neglected they restrict the air passage to the carburetor and have the same effect as that of choking the carburetor.

Oil filters shall be cleaned or new cartridges installed whenever needed. The length of time an oil filter may be used without attention depends on the conditions under which the equipment is worked and how often the oil is changed.

Oil changes are to be made when required. The length of time that equipment may be operated between changes will depend on the mechanical condition of the equipment, and the kind of work that it is doing.

Radiators, pumps, and hose connections shall be inspected at regular intervals.

Brakes shall be kept in repair at all times and tried out at regular intervals to see that they are functioning properly.

Motorized equipment which is able to travel under its own power shall not be trailed or towed.

No motorized equipment shall be coasted on grades or hills. The clutch and transmission shall be engaged at all times when the equipment is in operation.

Governors, which are installed on various motorized units, shall be functioning at all times and shall not be tampered with.

Mileage recording instruments such as speedometers and odometers must be kept in repair and operating at all times.

Accessories other than standard or original equipment shall not be installed on any unit until permission has been secured from headquarters.

Fire extinguishers shall be kept filled and in working condition at all times.

Read the instruction books accompanying each piece of equipment, and familiarize yourself with various adjustments as outlined by the manufacturer.

Do not overload the equipment. It is designed and built for a maximum load by the manufacturer and if his recommendations are exceeded, the investment is being jeopardized, the life of the equipment shortened through excessive strain, and voided any guarantee that the manufacturer has placed on it.

All operators of motorized equipment shall see that their equipment has identification discs, insignia, satisfactory lights or reflectors, both front and rear, and flags if safety requires them.

All operators shall take pride in the appearance of their equipment and keep it cleaned and in good repair, going over it at regular intervals, inspecting it for loose nuts and cap screws, broken or lost parts, and needed repairs. Every employee should make an



effort to deliver the maximum in work accomplished with a minimum of expense in upkeep.

3.28                      Employees are paid wages that warrant the securing of  
Operating                      the better class of workmen, interested in their work  
Personnel.                      and anxious to give full value in return for their  
wages. Employment of minors on work requiring motorized equipment operation shall not be permitted.

Operators who are careless or reckless with State equipment shall be discharged immediately. Any abuse of equipment that is brought to the attention of a Division Engineer, Resident Engineer, Maintenance Superintendent or Foreman by a mechanic must be thoroughly checked and the necessary action taken to stop such abuse.

Employees shall not criticize any state mechanical equipment except in a constructive way, and then only to responsible members of the Department whose business it is to follow up and check these matters. Loose and thoughtless criticism only leads to trouble and embarrassment for those responsible for the purchase and upkeep of this equipment.

When a new piece of equipment is assigned, do not immediately decide that it will prove unsatisfactory, or that the manufacturer is wrong in his design, as the equipment was built for the work it is supposed to perform, and considerable time and money were spent in perfecting it before it was placed on the market. Do not be prejudiced but give it an impartial trial.

Operators and drivers of motorized equipment are not expected to be experienced mechanics, nor are they required to do major overhaul or repair work, but they must keep the equipment clean, well

lubricated, and all bolts and nuts tight, and make minor repairs. Therefore each operator and driver must own, carry, and maintain the following kit of small tools:

- 1 Set of socket Wrenches 1/4" to 7/8" SAE
- 1 Ten-inch Adjustable Wrench
- 1 Fifteen-inch Adjustable Wrench
- 1 Pair Adjustable Pliers
- 1 Set of Chisels 3/8", 1/4" and 3/4"
- 1 Set of Punches, 1 each 3/16" pin, 5/16" common, 1/4 drift.
- 1 Six or Eight-inch Screw Driver
- 1 Twelve or Fourteen-inch Screw Driver
- 1 24 Oz. Ball Pein Hammer

Special tools and equipment such as grease guns, jacks, hub wrenches, tire chains, etc., peculiar to a certain piece of equipment will be furnished by the State and shall be checked out and in to the driver or operator of the equipment by a shop mechanic. Any shortage which cannot be explained or accounted for in a satisfactory manner by the operator or driver, when his assignment to duty on the equipment is completed, shall be replaced at his expense.

Under no circumstances is an operator or driver of motorized equipment to overhaul or attempt to overhaul a carburetor, generator, starting motor, magneto or distributor, as this work requires special tools and expert knowledge. Such repair work shall be done by a State Mechanic if possible.

3.29                      The most prolific source of motor car trouble is speeding. Drive at a reasonable rate of speed.

Operation                      Have the battery, tires and oil changes taken  
of Cars

care of at regular intervals. Leaks in the cooling or oiling system shall have immediate attention, and brakes shall be kept in good repair.

All unusual noises should be investigated and the

cause located, for it may be the fore-runner of something serious. Only by close attention to the various details constituting the make up of an automobile can the desired service, with a minimum of interruptions, be obtained.

3.30                      The proper gear or speed in which to operate a truck  
Truck                      depends upon the type of work being done. It is not  
Operation.                essential to operate in a speed in which the engine will  
have to labor at its maximum output to produce sufficient power to handle the job. Under these conditions the truck shall be operated in a lower gear which will eliminate heating, and excessive wear on all working parts because the motor will not be forced to labor and its performance will be smoother.

                            The motor shall at all times be kept as free as possible from dirt, and the magneto or distributor protected, not only from an accumulation of dirt, but also from grease and oil.

                            Truck tires are expensive and their life is considerably shortened through improper wheel alignment or operation when under-inflated.

                            Brakes must be kept in good repair and functioning properly at all times.

                            Sufficient water or an anti-freeze solution shall be maintained in the radiator at all times during the operation of the equipment. Under no circumstances shall a volume of cold water be poured into the radiator when the motor is hot; allow the engine to cool off first.

                            Should a knock develop in the motor, ascertain the cause if readily discerned, and report to the mechanic who is in charge of the equipment. Check the lubricant in the transmission and differential case at regular intervals, and change the oil when necessary.



Dump trucks equipped with hydraulic hoists shall be checked regularly for leaks and kept charged with the proper oil.

Whenever it is necessary to use chains on any make of four wheel drive truck, all four wheels shall be chained.

3.31 (a) GENERAL. When excessive wear occurs in the control mechanism of a grader unit, so that it is impossible to obtain positive control, necessary repair parts shall be requisitioned.

Blade lifting arms are fitted with take-up connections which shall be frequently inspected and tightened when wear develops.

All bolts and rivets shall be kept tight and all broken or lost ones replaced immediately with the proper size.

Bent blade horns or moldboard supports shall be straightened immediately or replaced with new ones.

Worn cutting edges shall be replaced previous to any injury to moldboard or braces thereon.

All wheels fitted with roller bearings and all gear housings shall be kept full of the proper lubricant.

Solid rubber tires on all grader units shall be replaced when worn to within one inch of the tire rim.

Operators of leaning wheel graders shall always keep the wheels at the proper angle to the work so as to balance the thrust load and prevent undue wear on the wheel bearings and spindles. When a leaning wheel grader is being moved to or from work, or is stored or left standing the wheels must be in a vertical position.

When an extension on a grader moldboard is being used, extreme care shall be taken to eliminate excessive strain on the grader.

(b) PULL TYPE GRADERS. Care shall be taken to keep the pole of the grader at right angles to its king bolt, so that strains will not be against the fifth wheel, or undue cramps caused to the steering devices. This can only be accomplished with a short and positive hitch on surface maintenance.

No pull type grader shall be operated without the standard size safety pin made up from the recommended material.

No pull type grader shall be operated, towed or trailed without a responsible employee on the operator's platform. A safety chain must also be used.

(c) MOTOR PATROL OPERATION. Motor patrols shall only be used on surface maintenance, and shall never be used on ditching operations. Should it be necessary to use a motor patrol off of the road surface, such as mixing oil stock material, the operation shall be confined to a smooth level surface.

The governor on motor patrol power units shall be operative at all times and shall not be tampered with except by a mechanic authorized to do so.

The pumps on hydraulic motor patrols shall never be run unless there is a supply of oil for the pump to draw from. A good grade of hydraulic oil should be used.

3.32

Tractor  
Operation

(a) GENERAL. The air cleaner shall be cleaned when necessary, so that it is operating efficiently at all times. The oil filter shall be serviced or cleaned whenever needed.

The oil shall be changed as often as required. This is controlled by the conditions under which the tractor is operating.

All gear cases shall be filled to the proper level with the grade of lubricant required.

No tractor shall be operated with one cylinder "missing".

Avoid starting the tractor with a jerk. Make the tractor take the load gradually; it will save gears and tires or tracks.

(b) WHEEL TYPE. Watch the front wheel alignment and do not allow the rear wheels to spin.

(c) CRAWLER TYPE. The tracks must be kept at the proper tension. Track joints or other moving parts, subject to contact with dirt, etc., must be kept free from oil or grease.

The tractor shall be gone over each morning prior to beginning operations, giving special attention to the tracks and the track operating mechanism. Repairs for this type of equipment are expensive.

In the field, every effort should be made to secure the most capable and experienced operators obtainable.

3.33 (a) "V" & ONE-WAY. The push plows, both "V" and  
SNOW PLOWS One-way type, are a very severe strain on truck equipment. Every precaution shall be taken to eliminate possible breakage.

It is desirable to have speed with this type plow, but the truck shall always be operated at such a speed that the driver has complete control.

Repairs to the plow or plow mounting should not be neglected, but shall be taken care of at once.

(b) ROTARY. The rotary snow plows are not to be used to remove snow by pushing it. The truck shall be operated at a speed that



will keep the rotors full of snow. By crowding a rotary snow plow undue strain is placed on the working parts and often times the amount of work accomplished is cut down.

3.34 All crushers shall be operated at, or slightly higher than, their rated speed. Never below. In feeding Crushers. crushers, the best results will be secured if no material smaller than the desired size is permitted to enter the crusher, as it has a tendency to pack and places a severe strain on the working parts. Place grizzly bars ahead of the crusher to eliminate fine material, if the pit runs any appreciable amount.

(a) JAW. There is very little that can go wrong on jaw crushers if the bearings on the main shaft and the eccentric are kept adjusted and well lubricated. In operation, these units must be oiled and greased regularly.

(b) GYRATORY. On gyratory crushers, it is very necessary that the bolts around the frame be kept tight, so that there is no movement. The oil tank should be at least three-quarters full of oil at all times. The tank should be cleaned when necessary and new oil put in. Regular inspection shall be made to be sure oil pump is working.

3.35 Very specific instructions are given operators before Boilers starting work on a boiler or retort. These instructions and Retorts vary according to the particular equipment and to the location in which the boiler is to be used, and, therefore, only a few general instructions are herein mentioned. The boiler shall be kept clean, and only the best water obtainable shall be used. When necessary, boiler compound shall be used. Flues shall be cleaned as often as necessary and

scraped at least twice every day. Retorts or pumps shall not be "high-balled" and the coils and pump shall be well drained and cleaned before moving or storing. Both boilers and retorts are mounted on trailers and shall not be towed at an excessive speed.

3.36

Safety  
Instructions  
for Operators.

1. Be courteous at all times.
2. Be neat about your personal appearance.
3. Regulate the speed of your equipment according to road and weather conditions.
4. Slow down at road intersections.
5. Do not pass the vehicle ahead on curves, grades or hills.
6. Do not follow the vehicle ahead too closely.
7. Stay in line when the traffic is heavy.
8. Stay on the right side of the road when on the way to and from work.
9. Do not stop on the roadway.
10. Do not move against traffic unless the nature of the work makes it unavoidable.
11. Place a torch to the rear of equipment if stalled at nite.
12. Place a flag to the rear of equipment if stalled in daylight on the roadway
13. Before backing, be sure nothing is behind you.
14. Do not make sudden stops.
15. When making left turn give on-coming traffic sufficient warning.
16. Use caution when children are on the road.
17. Protect equipment at all times with the necessary flags and reflectors.
18. Protect all towed equipment with a tow chain in addition to regular hitch, and display a red flag (18 inches square) on the front end of the towing unit and the rear end of the towed unit. Flags are to be placed on the left hand side.



## CHAPTER IV

### SURFACE MAINTENANCE

#### 1.GENERAL.

4.1 Maintenance methods must be varied according to the  
Methods surface types, class of material, and volume and class  
of traffic. However the following items are more or  
less common to all types of surface, and shall be closely followed.

4.2 It is the general policy to remove snow from the regular  
Snow travelled routes except high mountain passes and light  
Removal. traffic roads which neither justify the hazard nor the  
expense.

Snow removal operations should start with the storm or  
as soon as the fall is of sufficient depth for the equipment to remove it,  
and should continue until the road is clear at the end of the storm.

Arrangements shall be made for relief crews so that no  
crew shall work over eight hours per day.

During snow removal operations, extra precaution must  
be taken when passing or being overtaken by other traffic to avoid throwing  
frozen chunks of snow through windshields or dangerously obscuring the  
vision of other drivers. The speed of the snow plows must be reduced even  
to the point of stopping if such is necessary for the safety of other  
traffic. A sudden swerving of snow plow equipment when striking hard,  
frozen masses of snow has frequently caused collisions with other vehicles,  
and equipment operators must exercise increased vigilance under such con-  
ditions. All snow removal equipment shall be amply supplied with small  
tools, such as tow chains, shovels, picks, bars, jacks, etc.

Operators of snow units should give especial attention  
to motorists during storm periods. Cars stalled in drifts and ditches



should be towed out. In extreme conditions towing service should be rendered. After a storm is over and the road is passable to traffic, additional work must be performed in the way of widening and removing snow from shoulders. As a preventive measure, in territory where drifting is prevalent, precautions shall be taken in removing piles of snow that might tend toward blocking the road by forming drifts.

4.3                      All ditches and culverts shall be kept clean at  
Drainage                      all times. To prevent the accumulation of a  
                                 large volume of run-off water which might cause  
excessive wash or scour, side ditches or drains shall be blocked to confine water wherever cross drainage is provided. On all heavy snow sections during the spring break-up, drainage shall be opened to prevent damage to the road surface. On heavy grades or high fills, constructed of disintegrated granite or material subject to wash, gutters shall be constructed of timber or metal with necessary chutes to convey flow beyond toe of slope.

4.4                      Where cross roads intersect the roadway the in-  
Cross                      tersection shall be maintained to the right of  
Roads.                      way lines on both sides. Where necessary to  
prevent rutting and the accumulation of mud on the road surface they shall be surfaced with gravel. In all cases, road approaches or crossings will be as low as the shoulder of the highway which they join or cross. Cross drainage will be maintained on all road approaches when necessary or advisable.

4.5                      Slides and washouts shall be immediately repaired,  
Slides and                      removed, or barricaded, and the proper danger signs,  
Washouts

flags, and lights erected and maintained a sufficient distance on each side of the slide or washout to allow ample time for traffic to stop before arriving at the danger point. All warning signs, etc., shall be removed when repairs have been completed. All slide material, as far as practical, shall be utilized in widening adjacent fills or repairing washouts in the immediate vicinity.

4.6                      All shoulders shall be maintained to full width and  
Shoulders.                regular alignment. The shoulder material shall be flush  
                             at all times with the edges of the improved surface of  
the road and sloped to the outside at a rate of 3/4" to the foot to facilitate road surface drainage.

4.7                      Any large rock which may cause damage to passing traffic  
Oversize.                by collision or high centering shall be immediately  
                             removed. All other oversize larger than the original  
surfacing material must be raked or forked off the roadway when blading operations have been completed.

4.8                      When it is necessary or desirable to tear up the sur-  
Windrowing                face of the roadway, the material shall be windrowed  
Material.                on the shoulders of the road with completion of work  
                             for the day, never in the center. If necessary for protection of traffic,  
bombshells and flags shall be used as warning on both ends of windrow and  
all breaks in windrow.

4.9                      All bridge approaches shall be kept in such condition  
Bridge                    that no bumps or jump-offs will occur at the point  
Approaches.               which connects the grade with the bridge proper.

4.10 On sections which cross railroad tracks at grade,  
Railroad extra care must be taken to insure that no loose  
Crossings. gravel, earth, or other material is bladed or  
dragged onto the track or left near the track in such a manner that it  
might get on the track under traffic. Derailments resulting in death and  
great property damage have been caused by this negligence, and, therefore,  
this precaution must be given special attention. Extra precautions shall  
be taken to avoid getting any of the road material wedged in openings  
between the inside of the rail and the crossing planks. Should any material  
be bladed into this opening it should be removed immediately.

4.11 All projecting blades or moldboard of graders,  
Protecting drags, or maintainers when in use on the road sur-  
Equipment and face or extending out over it shall display a red  
Men. flag not less than 18 inches square. All maintenance operations requiring  
hand labor or the concentration of equipment on the roadway shall be protect-  
ed at both ends at all times by the proper signs, flags, flagmen or lights  
as the occasion demands. Such warnings shall be removed immediately upon  
ceasing operations.

## 2. SURFACE TYPES AND THEIR MAINTENANCE.

4.12 An earth road shall be shaped to cross section in  
Earth early spring and late fall with a blade grader at  
Roads. which time the moisture content is favorable for  
such work. The surface shall be crowned to assist drainage, but never shall  
this crown be in excess of a rate of 1/2" to the foot.

All curves shall be super-elevated and compacted.  
The amount of super shall depend on the degree of curvature and will increase



in proportion as the degree of curvature increases. The maximum super shall be obtained at the P.C. and P.T. of the curve and this super shall be carried throughout the length of the curve. The run-off from the super at both ends of the curve shall continue into the tangents on the ends of the curve for a distance varying from 150 lin. feet to 300 lin. feet before returning to the standard crowned section, providing the alignment of the road will permit. Division Engineers, being best fitted from practical experience and knowledge of local conditions to furnish such information, shall instruct maintenance employees as to super-elevations to be used on different curves within their respective Divisions.

Earth roads during the operating season shall be bladed during or as soon after storms as the material will permit. Blading operations shall be continued until the material is thoroughly compacted. When blading operations on an earth road are in progress, do not open up more work than can be completed during the day so that the road may be safe for traffic during the night. A ridge of material shall never be left in the travelled roadway.

4.13                      Every effort shall be made to maintain all crushed gravel  
Crushed Gravel           or rock surfaces in a well shaped, smooth, compacted con-  
or Rock Surfaces.        dition. When in this condition, surfaces of this nature  
best resist the effects of weather and traffic. These results can best be  
obtained by starting intensive maintenance as soon after the spring break-  
up as road conditions will permit. Advantage should be taken of the moisture  
present in the road materials to insure thorough compaction of the surface.  
ing. In order that gravel or rock surfaces may be given the maximum  
attention in the spring, all ditch cleaning and slide removal work shall  
be completed in the late fall before the freeze-up.

Gravel or rock surfaces should be maintained with a crown of  $1/4$ " to the foot. Curves shall be super-elevated in accordance with instructions set forth under "Earth Roads". Advantage shall be taken of every rain during the maintenance season by continuous blading of the material while it is wet. Excessive loose and inert surface material shall be bladed to the shoulders well beyond the travelled portion of the roadway. Care must be taken to see that this material is not lost over the shoulders of the road.

On sections which are well compacted, and on which only an occasional hole or depression occurs, patching with wet stock pile material containing sufficient binder gives excellent results providing the holes are cut to a square or rectangular shape with vertical sides and to the maximum depth of the hole. All dry and loose material should be removed before back-filling. Weak places in the surfacing, and large depressions which hold water shall be reinforced or filled in with stock pile material. An excessive amount of material should not be used as it may cause a hump in the surface and destroy the riding qualities of the roadway.

When it is necessary to use binder material to set up a gravel or rock surface, it shall be thoroughly mixed with the aggregate before final shaping, spreading, and compacting. Binder shall not be used on projects surfaced under oiling specifications without consent of the Testing Engineer, and the amount and character of the material as set forth by him shall be strictly adhered to.

4.14	All depressions that trap water on oiled sections
Oiled	will be noted and carefully marked during or
Surfaces	immediately after a rain, while they are clearly



outlined by the water standing in them. These depressions shall be brought to true grade and section as early as possible by patching with either pre-mixed material or with a skin or wet patch using SC 3 or 4 or RC 2 or 3 asphaltic binder and crushed gravel graded from 3/4" to dust.

The method to be used in patching shall be governed by the shape, size, and depth of the depression. Where a depression is less than an inch in depth, the skin or wet patch is preferable. In making a skin or wet patch, care must be taken before applying the oil to see that the surface is dry, well cleaned, and free from loose material, especially dust.

An excessive amount of oil shall not be used since this will cause rolling under traffic or bleeding and result in "pick-ups" or peeling of the surface adjacent to the patch. These "pick-ups" often adhere to the wheels of traffic and are later deposited upon the road surface causing "scabs" which destroy riding qualities as well as cause undue strain on the surface by impact from the traffic passing over them. In making a patch with a pre-mixed material, the depression shall be cut out to a square or rectangular shape with vertical sides, and to a uniform depth, depending on the maximum depth of the depression. The exposed surface shall then be coated with a light painting of oil before placing the pre-mixed material in the depression. The pre-mixed material shall be well tamped and brought flush with the adjoining surface.

Ravelled edges and "chuck holes" in oiled surfaces shall be taken care of and repaired as outlined in the preceding discussion on filling depressions.

During the period required for patches, sealing, and new work to cure, oiled surfaces shall be inspected at frequent intervals for signs of bleeding. The time required for curing will vary greatly as the



nature of the oils used, climatic conditions, and the volume and type of traffic will all have their influence. Under certain conditions, especially where new penetration work has been completed late in the fall, the curing may take as long as six months or more.

Where bleeding occurs, the surface shall be covered with a coating of coarse, clean, sand or screenings, by means of a mechanical spreader or by hand spreading. These sections shall be inspected at regular intervals and shall be given special attention during hot weather and after rains.

Corrugating or wrinkling of oiled surfaces in most cases can be traced to the presence of water or moisture in the surface material or in the base. However it is sometimes caused by an excessive amount of oil or the placing of the oiled surface on a loose or dusty base. All such undulations, if not extensive, shall be scarified to the bottom of the mat, and the oiled material windrowed on the shoulders by blade graders with the regular maintenance forces. If the trouble is due to water, sufficient time shall be allowed for the drying of the base and the windrowed material shall be re-mixed until dry before replacing the mat. If the condition has been caused by excessive oil, sufficient uncoated material similar to that used in the mat shall be added to the windrow and thoroughly mixed before replacing the mat. If a loose base is responsible for the corrugations, it shall be bound up and compacted before replacing the mat. If corrugations are of such an extent that the repair of them will necessitate the concentration of equipment other than the regular maintenance machines, the work shall not be undertaken before the Division Engineer is consulted or the matter referred to headquarters. In all cases where the mat is torn up, it is imperative that it be thoroughly pulverized and mixed before re-spreading and re-shaping.

When an oil mixed surface starts to ravel, it is caused either by insufficient oil or poorly graded aggregate that lacks sufficient fines, especially those fines passing a ten mesh screen, or a combination of the two conditions. This ravelling may be corrected by tearing up the mat and adding oil or by adding oil and fine material with the qualities desired if obtainable. The mat must be thoroughly re-mixed before spreading. After it has been compacted, and should it still show tendencies of ravelling or if no fines were added although desired, it is essential that the surface be seal coated with a heavy asphaltic material such as SC 4 or 95 Plus Oil or RC 3 Cutback and covered with clean screenings or crushed gravel.

If the surface becomes open by cracking or checking, it shall be sealed prior to winter weather by applying  $1/8$  to  $1/4$  of a gallon to the square yard of heavy oil or cutback asphalt, adding the necessary cover of clean mineral material.

4.15 For the convenience and simplicity of mixing oil treated Oiled Stock material to be used in connection with maintenance of Piles. oiled sections, a portable pug mill has been constructed. This pug mill will be moved from one Division to another during the summer season for operation as the needs warrant. It will be under the direct charge of a foreman who is familiar with the operation of the machine. When it is moved into a Division, the Division Engineer should take advantage of the opportunity and mix as much material as possible within the time allotted. All suitable mineral aggregate now in stock piles adjacent to oil treated sections shall be mixed with an asphaltic binder such as SC 3 or 4. Under no circumstances shall the asphaltic material used in mixing operations exceed 5% by weight of the dry mineral material. Great care must be taken in piling the treated material and in every case the piles should conform in every detail with the instructions set forth in Paragraph 5.18 of this manual.



4.16 (a) Asphaltic concrete shall be patched in practically the same manner as set forth under oiled surfaces, except that the asphaltic binder should be the heaviest grade of oil or cutback asphalt obtainable. The cutback is preferable. Bad riding qualities caused by corrugating can be greatly improved by skin patching with clean crushed rock or gravel and cutback asphalt. If the undulations are extensive a retread of clean, crushed, mineral aggregate and cutback asphalt shall be laid in much the same manner as road mix. Extensive repairs of any nature on this type pavement shall not be undertaken without consultation with the Division Engineer and headquarters.

(b) Concrete. Repair all settlement, spall or buckles with asphaltic oil and rock or gravel. Thoroughly clean the surface by brooming. Apply light prime coat of asphaltic material making sure that the entire surface is coated, then cover immediately with pre-mixed material or finish with a wet patch as the needs require.

Keep all pavement cracks sealed with a heavy asphaltic material. Get the asphalt in the crack, not over the pavement. Keep expansion joints filled with heavy asphaltic material and cover with coarse sand screenings which will pass a 1/8" screen.

Keep shoulder material flush with pavement edges at all times. This applies to all types of pavement.



## CHAPTER V

### MISCELLANEOUS MAINTENANCE

5.1                      Strength of dynamite is rated according to the percentage  
Blasting.                      of nitro-glycerin contained. In dynamite, one stick of  
                                 40% equals 1.4 sticks of 20% or 0.78 stick of 60%. In  
requisitioning dynamite specify strength, size, length and whether required  
for wet work.

                                 Use 20% for blasting stumps and moving other than rock  
yardage. Use 40% and 60% for mud capping boulders and moving rock yardage.  
Before shooting have flagmen with red flags stop all traffic a safe distance  
from the explosion.

                                 Do not store caps and exploders with other explosives.

                                 Permit must be secured from the local forest ranger be-  
fore any blasting is done in National Forest areas during the fire season.

5.2                      All important structures shall be inspected by the  
Bridges.                      Division Engineer twice each year, once prior to and  
                                 once following the winter season. The Resident Engineer  
or Maintenance Superintendent shall inspect all structures in his territory  
at least once every three months, and the Maintenance Foreman or patrolman  
shall inspect all structures in his territory at least once every month.  
Serious defects which endanger traffic or the structure itself shall be re-  
ported immediately to the Division Office which in turn shall advise head-  
quarters if necessary. Periodic inspections of important structures will be  
made by a representative of headquarters office. The following outlines the  
items to be considered:

1. Condition of approaches (surface, shoulders and slopes).

2. Condition of asphaltic wearing surface or of planking if  
a timber floor. Note excessive wear or undue vibration.

3. Condition of guard rails and wheel guards.
4. Looseness or undue vibration of steel or timber truss members.
5. Condition of paint.
6. Cracked or broken stringers.
7. Crushed bearings or decayed timbers.
8. Broken chord members, sheared splices, etc.
9. Condition of slide plates, rockers or expansion joints.
10. Condition of piers or abutments.
11. See if clearing of channel is required.
12. Note erosion or washouts.
13. Note and correct any fire hazard.
14. Note any other items needing immediate or early attention.

5.3                                      All buildings, shops, garages, and camps must be  
Buildings                                      kept orderly and sanitary, and precautions must be  
and Camps.                                      taken to guard against fire. In case buildings  
or camps are within the limits of the National Forest, rules in regard to  
fire and sanitation must be strictly adhered to.

5.4                                      All culverts shall be constructed in accordance  
Culverts.                                      with state standard specifications. Keep them  
clean at all times. Place cobble-stone bottoms  
at inlets and outlets, if scour occurs, and grout them if necessary.  
Straighten and clean the channel at the outlet end. If necessary construct  
a wall or dike to direct water through the culverts. Clean inlets and out-  
lets of all culverts prior to winter and spring break-ups, and as often as  
may be necessary at other times.

5.5 Detours shall be marked at each end by a standard  
Detours. "DETOUR - 400 FEET AHEAD" caution sign, supplemented by  
a red flag and standard "ROAD CLOSED" barricade illuminated at night by red flashers or lanterns. All intersection roads on the detour shall be marked by standard detour signs. The foreman in charge should inspect the detour daily to make sure that all signs and markers are in their proper place.

5.6 All ditches shall be carefully inspected by the Resident  
Drainage. Engineer or Maintenance Superintendent in the late fall  
and early spring before the break-up, and any accumulation of slides, weeds, and other debris shall be promptly removed.

All surface water which accumulates on the roadway shall be promptly drained into ditches and the necessary action taken to prevent a repetition. All obstructions in the channels of streams adjacent to highway embankments which cause scour or wash that would tend to endanger the roadbed shall be removed when the opportunity presents itself. Any reinforcement necessary to prevent the wash and scour of highway embankments which are in close proximity or parallel to a stream shall be made of dry rock paving, cement rubble masonry, timber cribbing, or by other satisfactory means. All irrigation structures in use, particularly inverted syphons, shall be frequently inspected for leaks and for weakened inlet or outlet embankments.

5.7 (a) RIGHT OF WAY. No encroachment on highway right of  
Fences. way by adjacent property owners will be allowed, and  
any attempt to do so shall be immediately stopped by  
the Resident Engineer or Maintenance Superintendent and the Division Office notified.



All highway encroachments upon railroad property that are covered by leases or agreements which stipulate that the Highway Commission shall maintain right of way fences are interpreted to mean only those sections of fence opposite or adjacent to sections that are kept in good repair by the Railroad Company. The sections of railway fence for which the state is responsible shall only be maintained to the same standard as the opposite or adjacent fence.

All State employees shall be watchfull for dead animals upon the railway right of way in the proximity of highway encroachments. When a dead animal is found in such a location the employee shall ascertain if possible where the animal entered the right of way and should there be any possibility of attaching any blame for the accident to the Highway Commission, a written report, giving full details, shall be submitted to headquarters through the Division Office.

Each Division Engineer shall familiarize himself and his responsible employees with the locations and obligations attached to all highway encroachments upon railroad or other private or public property within his Division. This must be rigidly carried out in order that the expense incidental to such obligations may be held at a minimum.

(b) SNOW FENCE. Where possible on sections subject to drifting, snow fence should be erected to prevent the forming of drifts on the travelled roadway. Only by careful study of the local topography and of the prevailing wind can snow fence be erected so it will offer a maximum protection with a minimum outlay. The needs can best be determined by observation of conditions as they actually exist in the field during severe storm periods. The erection of snow fence shall be according to the details shown on blue print for "Wood Slat Snow Fence" which will be furnished upon request.

In most localities which are subject to high winds, it will be found advisable to remove the snow fence during the seasons when it can be of no benefit as the vibration greatly shortens the life of the fence by breaking the wires that hold the slats in place causing considerable unnecessary repair work. Also when left standing, it is subjected to the depredations of live stock. When the snow fence is taken down, it shall be stored where it will be safe from fire, theft, and other acts of vandalism.

5.3 Frost boils occur in all types of surfaces, subjected to Frost long severe cold spells, where there is an excessive Boils. accumulation of water in the sub-grade. The character and composition of the material used or present in the roadway is probably the controlling factor in the collection and retention of water although volume and type of traffic is the detrimental contributing factor which determines the amount of the damage to the road surface. Due to the diversified nature of the contributing factor, each individual frost boil presents its own problem which can only be solved by a concentrated study of the local conditions and topography. Therefore, no effort will be made to establish a criterion which could be universally adopted, but the installation of french drains, tile or perforated culverts have proven adequate in many instances for the correction of the trouble. No extensive operation for the amelioration of frost trouble shall be undertaken without the consent of the Division Engineer. Any undulations or other hazards caused by frost action which jeopardizes the safety of the traffic shall be amply protected both day and night by the proper signs and signals until the hazardous condition has passed or been corrected.



5.9 All guard rail shall be constructed in accordance  
Guard with the standard specifications and must be in-  
Rail. spected at frequent intervals for dry rot and other  
defects which may weaken it and decrease its value as a safety factor to the  
travelling public. All broken or damaged guard rail shall be repaired  
immediately and at all times it should be kept true to line and grade and  
well painted. Do not apply paint to a damp surface, nor during rainy,  
foggy or freezing weather. Remove all paint scale with stiff wire brush.  
Thin paint with linseed oil, not turpentine or gasoline. In case of the  
cable type, turn buckles should not be loosened for the winter months to  
allow for contraction as a loose cable greatly impairs the efficiency of  
the guard rail.

5.10 Mail boxes shall be kept off of guard fences and  
Mail structures. Wherever possible have mail boxes  
Boxes. placed where the carriers car will not be stopped  
on the surfaced portion of the highway. In some cases it may be found  
necessary to do a small amount of shoulder widening and surfacing to  
accomplish this safety measure. All mail boxes shall be erected and main-  
tained by their respective owners in such a manner that they will not be  
unsightly.

5.11 The installation of all new road approaches after  
New Road the completion of the highway must be approved by  
Approaches. the Division Engineer and built under his super-  
vision. The Division Engineer will determine the size of the drainage pipe  
under the approach. It must be of metal or reinforced concrete. No wooden  
boxes will be allowed.



All costs in connection with the installation, including the culvert, must be paid by the party desiring the approach. It is desircous to have road approaches surfaced with crushed rock or gravel to the right of way fence. This will tend to prevent vehicles, entering the highway, from damaging the edge of the surfacing and will eliminate to some degree the depositing of undesirable material upon the travelled section.

5.12                      Where drinking fountains have been erected on state high-  
Roadside                      way right of way and their location and design have been  
Fountains.                      approved, the sights shall be maintained in a neat and  
orderly condition by the regular maintenance employee. Especial attention shall be paid to eliminate the possible contamination of the water supply. Suitable signs shall be erected and maintained, notifying the public as to the location of the fountain and as to whether or not the water is to be used for drinking purposes. Sights of this nature suitable for future development should be investigated and reported to headquarters accompanied by a proposed design of the structure to be erected and an estimate of the cost to be incurred.

5.13                      Any person or persons dumping or leaving upon any highway,  
Rubbish.                      highway right of way, or within 200 yards of such public  
                                 highway, any garbage, rubbish, or dead animals are violat-  
ing the state law. Such violations shall be reported by the Resident Engineer or Maintenance Superintendent to the local authorities with the request that action be taken against the offenders.

5.14                      Wherever a traffic hazard exists due to ice, frost, or  
Sanding of                      moisture on smooth pavements or oiled sections, provision  
Icy Surfaces.                      shall be made for storing dry sand prior to the winter,

and such sections when dangerous shall be sanded, using a rotary sander attached to a truck, or if necessary by hand methods. Where using a rotary sander it should be adjusted so that the entire roadway will be sanded in one operation. In some instances it may be found advisable to add calcium chloride to the sand to increase its penetration when applied to icy surfaces and to prevent the sand from becoming frozen while in the stock pile. Under no circumstances shall calcium chloride be used in excess of 20% by volume as an excessive amount has a detrimental effect on oiled surfaces.

5.15                      New service stations built adjacent to the highway  
Service                      must be so located that none of the construction  
Stations.                      will encroach upon the highway right of way and the  
approaches to and from the stations shall not obstruct the side drainage.  
Also they must be constructed so that cars when stopped for filling will  
not be upon highway right of way. If necessary to install culverts under  
the approaches, the installation shall conform in every respect to the  
regulations set forth under Paragraph 5.11.

5.16                      At all points along the highway where the sight  
Sight                      distance may be materially increased and the  
Clearing.                      traffic hazard decreased by clearing away timber  
growth on adjacent property, an effort shall be made to get permission  
from the property owner to do so. In clearing of this nature all scrub  
or small growth shall be cleared to the surface of the ground. Should the  
growth consist of or be interspersed with trees having a diameter of  
five inches or greater, an effort should be made to obtain the sight dis-  
tance desired by trimming rather than cutting them down. Slashings from



clearings of this nature shall be piled and burned when the opportunity presents itself.

5.17                      All advertising, guide, warning, and political signs  
Signs.                      which are erected or placed on highway right of way  
                             are unlawful and shall be removed immediately, except  
those giving distance to telephone service, standard warning, directional  
and route signs placed by the Highway Commission or those placed under  
their authorization. This also applies to signs attached to fences bordering the highway or on telephone, telegraph, or power line poles. Any trouble arising from the removal of unlawfully placed signs shall be reported to Headquarters Office through the Division Office.

The shape and color combination of signs each have their own significance. The octagonal sign is used to indicate a stop. The diamond shape signs are used to indicate any condition inherent in the road itself, requiring slow speed or caution on the part of the driver. The circular sign is used as an advanced warning at railroad crossings only. The square shaped signs are used to indicate any condition requiring caution that is not inherent in the road itself but due to adjacent conditions such as schools, cross roads, etc. The rectangular shaped signs of various dimensions are used to carry directional information and restrictions of use or of benefit to the driver. The shield shaped signs are used only to mark U. S. highways. Signs having a black design on a yellow background mean caution or get under control. Red background signs mean immediate danger. All direction, information, and restriction signs are black design on a white background, except that the "Rest Station" sign is white on a green background.



All precautionary or warning signs should be placed from 400 to 450 feet from the point of danger, and all curve signs should be placed the same distance from the actual beginning of the curve. Local topography often makes it necessary to vary this standard, but it should be followed as closely as possible. All signs shall be erected not less than five and never more than seven feet from the edge of the surfacing; and, in general, the center of the sign should be three feet and six inches above the crown of the surfacing. In order to avoid a glare reflected back to the driver, all signs should be turned toward the road so that the plane of the sign will intersect the center-line of the roadbed at an angle of 60°. The route markers should be placed at the same height and distance out from the edge of the surfacing as the warning signs, and one shall be erected at least every five miles. Where possible they shall be placed near culverts or other structures in order to cause as little inconvenience as possible during shouldering-up operations. On all oiled sections, signs warning off tractors with lugs shall be placed at each end and at all important intersecting roads. These signs shall be placed at right angles to the main highway. Slow signs must be placed at the end of all gravelled, oiled, or paved sections where there is a change to an earth section. "End of pavement" signs must be placed at the end of all oiled or paved sections. The large red letter "Slow" signs adopted by this organization are for use only in extremely dangerous places. Care should be taken to see that these signs are properly placed and that they are not used unless a real hazard exists.

All warning and direction signs of a permanent nature, except route and highway markers, shall be attached to a surfaced square 4" x 4" wooden post which has been previously painted with three coats of

outside white paint. All route and highway markers, except those erected within the limits of towns and cities, will be attached to a standard steel U shaped post. Route or highway markers erected within the limits of a town or city require a special set up which will vary with local conditions. The necessary bolts, washers, nuts, and lag screws used for attaching a sign to the post shall be galvanized. Any sign that is damaged in any way shall be immediately repaired or replaced by the patrolman. Any sign or other warning signal of a temporary nature shall be removed immediately after the need is passed. All signs or signals used for the protection of traffic, state employees, or equipment during the day, such as "Men Working", shall be removed at the end of the working day and never allowed to remain over night. Any person or persons defacing, damaging, or injuring any state highway guide, warning, or other sign is guilty of a misdemeanor. All patrolmen shall maintain a careful watch for any vandalism and report to his immediate superior any persons caught shooting or otherwise defacing state signs.

5.18                      All stock piles of sand, crushed gravel, and oil treated  
Stock                      material, shall be placed, where possible, on state high-  
Piles.                      way right of way or property and so located that they  
will not create a traffic hazard or cause snow drifts. The stock pile sites  
shall be free from rocks, brush, stumps, weeds, or any other obstruction  
or condition which might cause undue loss of material or interfere in load-  
ing operations by means of a mechanical loader. The site shall be well  
drained, especially for oil treated material. The stock piles must be so  
constructed that the least possible surface area will be exposed to the  
elements and shall be free from water traps. It is essential that the  
stock piles be maintained in such a condition at all times that they will



readily shed water. On all stock piles of considerable size, a sign stating "State Property Penalty for Theft State Highway Commission" shall be erected and maintained.

5.19                                      The law states that tractors with lugs or cleats  
Tractors.                                      are not allowed on the highway, but this should

   not be interpreted to apply to farmers who are  
cultivating land on both sides of the highway and who cross the highway  
occasionally at right angles to the center-line of the roadway. The use  
of planks for crossing purposes shall not be permitted as, without the  
proper precaution, they prove a distinct hazard to the traveling public.

5.20                                      State wide traffic counts will be taken only at  
Traffic                                      such times and places as may be designated by the  
Counts.                                      Headquarters Office. Special isolated counts may  
be taken for a particular purpose at the discretion of the Division Engineer.  
All changes of stations and all stations to be added shall be referred to  
Headquarters Office for approval. When a time is selected for a general  
count at all stations it must be taken regardless of weather conditions.  
Unless otherwise specified, counts will be taken for a four hour period,  
from 2 to 6 P.M., which represents 32% of a 16 hour count taken from 7 A.M.  
to 11 P.M., and the count shall be reported in detail to the Headquarters  
Office as a 16 hour count. The traffic shall be segregated into the various  
capacities as set forth on the regular traffic census form. Light trucks  
will be considered as trucks of less than  $1\frac{1}{2}$  ton capacity. All vehicles  
passing each given point shall be counted regardless of the direction.  
Traffic counts which are taken at road or highway intersections should be  
three way counts; that is, all roads leading from the intersection should  
be considered separate and independent roads, and the traffic tabulated



in accordance; which means that each vehicle passing the intersection must be counted twice, once on the road leading to the intersection and once on the road leaving the intersection. The detailed sheets shall be totaled and checked by the Division Office before forwarding to headquarters. Any unusual condition which effects normal traffic shall be noted on the back of the sheets.

5.21 \* All hidden headwalls and similar hazards shall be marked  
Warning by placing a warning post six inches square, painted  
Posts. white, and extending 18" in height above the shoulder of  
the road. All culverts and syphon headwalls, or any other structure or  
obstruction, which might be obscured during the winter by snow and which  
presents a hazard to snow removal equipment shall be marked by a suitable  
warning post, painted highway red. The top of the warning post shall be  
3½ feet above the crown of the road. Warning posts 8" square or round  
posts 8" in diameter, 6 feet long, and set 5 feet and 6" in the ground with  
20 foot centers should be used on many of the less dangerous curves and  
fills instead of the standard guard fence. These posts shall be painted  
white, except the first 8 inches above the ground which shall be painted  
black.

5.22 All dry rock, cement rubble or concrete retaining walls,  
Walls- or timber crib work along highway embankments shall be  
Retaining. regularly inspected as to their condition and need for  
repairs. Special attention should be paid to raveling of dry rock walls  
adjacent to railroad trackage, and to the weep holes in cement rubble  
masonry and concrete walls to see that they are unobstructed and function-  
ing properly.

5.23                                      When irrigation water is being diverted onto the  
Waste                                      highway right of way and it is endangering the  
Water.                                      the roadway or the safety of the traveling public,  
such condition shall be brought to the attention of the owner of the ad-  
jacent property or his responsible employee and request be made of him  
or them that the flow of water be stopped. If the owner or his responsible  
employee does not take care of the water, the Division or District Office  
must be notified immediately so that they may take the proper action as  
outlined in the penal code on the control of waste irrigation water.

5.24                                      The right of way shall be kept free of tall grass,  
Weeds.                                      weeds, and brush at all times, and especial atten-  
    tion should be given to weeds and brush, growing  
and accumulating around guard fences, sign posts, bridges, and other  
structures. All weeds and brush shall be burned as fast as possible,  
taking care to see that private or state property is not damaged incidental  
to this operation. In territories where an effort is made by the ranchers  
to control weed growth, cutting of weeds shall be so done that the seed  
will be destroyed.

5.25                                      TRAFFIC CENSUS. When requested standard traffic  
Standard                                      census forms are prepared in duplicate by desig-  
Forms.                                      nated field men, and submitted to the Division  
Office for check. The original is then forwarded to Headquarters Office.

    SNOW REMOVAL REPORTS. Weekly snow removal reports  
are prepared in triplicate by Resident Engineers or Maintenance Superin-  
tendents during the snow removal period. The original copy is sent direct  
to Headquarters so that it is received by Monday of each week. The dup-  
licate copy is forwarded to the Division Office and the triplicate is  
retained.



CRUSHER REPORTS. Daily crusher reports are prepared in triplicate by the crusher foreman with the original copy sent direct to headquarters and the duplicate copy to the Division Office.

OIL REPORTS. Oil report forms are to be prepared by timekeepers and inspectors under specific instructions.

INVENTORIES. Equipment Inventory Form 52-revised is prepared in triplicate by the timekeeper or foreman, and submitted to the Resident Engineer or Maintenance Superintendent. Original and duplicate are forwarded to the Division Office for approval before original is submitted to headquarters. This form is used only in connection with construction force account work.

Monthly Inventory of major equipment, Form 80, is prepared in duplicate at the close of the calendar month by the Resident Engineer or Maintenance Superintendent. The original is submitted to the Division Office for their files.

Monthly inventory Form 28 is prepared by the Division Office in duplicate at the close of each calendar month, and the original is sent to headquarters, to arrive by the 10th of each month.

An annual inventory, Form 88, is prepared in duplicate by the Division Office at the end of each fiscal year, and the original is sent to headquarters.

Monthly stock inventory, Form 79, is prepared in quadruplicate at the end of each calendar month by the Division or Resident Engineer where stores are kept. The original and duplicate copy are submitted to headquarters through the Division Office.

TRANSFER OF EQUIPMENT. Equipment transfer Form 89 is prepared by the Resident Engineer or Maintenance Superintendent, and mailed



direct to headquarters whenever a major piece of equipment is transferred from one district to another district or division.

UNSERVICEABLE EQUIPMENT REPORT. Unserviceable equipment report is prepared in triplicate at the Division Office; original and duplicate are sent to headquarters. This form is only used when condemning a piece of major equipment.

EMPLOYEES DAILY TIME CARD. Employees daily time card, Form 83, is to be used by shop employees in making time reports, and is also to be used to check up on unsatisfactory work done by mechanics.

SHOP WORK ORDER REQUEST. Shop work order request, Form 84, is to be used when leaving equipment in a shop for repair or overhaul. It assists in bringing work to the attention of the shop mechanic that might otherwise be overlooked.

GASOLINE, OIL AND DISTRIBUTION SHEET. Gasoline, oil, and distribution sheet, Form 78, is for use of field shops when there is a quantity of these supplies in storage.

VEHICLES INSPECTION REPORT. Vehicles inspection report is to be used by the field mechanic on his periodical inspection trips and will assist him in bringing to his immediate superior's attention careless and undesirable operators on the equipment.

CAR AND TRUCK SPECIFICATIONS. Car and truck specifications form is to be used by the Division Office and their mechanics to keep a record on various pieces of equipment as they are overhauled.

EQUIPMENT SERVICE RECORD. The equipment service record, Form 90, is to be used with each piece of motorized equipment. The operator of the equipment shall make the necessary entries as outlined on the form. When completed, the form shall be mailed or given to the Division or District Mechanic for his information and file.

5.26                   The two following bills have been enacted by the recent  
New Laws.               Legislature and have become laws:

(a) "Trucks, trailers and automobiles, which are of greater width than eighty (80) inches, upon any state highway of this State, shall be equipped with and display on each side of the body thereof a white, yellow or green light or reflector facing the front and on each side of the rear of such vehicle, a red light or reflector facing the rear."

"Whenever any trucks, trailers and automobiles upon a state highway shall be loaded with any material in such a manner that any portion of such load extends toward the rear three (3) feet or more beyond the rear of the body or bed of such vehicle there shall be displayed at the extreme rear end of the load, during the period between sunset and sunrise, a light or reflector plainly visible under normal atmospheric conditions at least two hundred (200) feet from the rear, and at all other times while such vehicle is upon a state highway, a red flag or cloth not less than sixteen (16) inches square shall be displayed at the extreme rear of said load as a warning signal to persons operating vehicles approaching from the rear."

"Each violation of this Act, shall constitute a misdemeanor punishable upon conviction by a fine not exceeding One Hundred Dollars (\$100.00), or imprisonment in the county jail not to exceed thirty (30) days, or both."

"All acts or parts of acts in conflict herewith are hereby repealed."

"This Act shall be in full force and effect from and after its passage and approval."

(b) "Permits for Excess Size and Weight. The State Highway Commission and local authorities in their respective jurisdictions

may in their discretion, upon application in writing and good cause being shown therefor, issue a special permit in writing authorizing the applicant to operate or move a vehicle of a size or weight exceeding the maximum specified in this Act upon any highway under the jurisdiction of and for the maintenance of which the body granting the permit is responsible. No permit shall be issued for a period of more than nine (9) months and every such permit shall designate the routes to be traversed and may contain any other restrictions or conditions deemed necessary by the body granting such permit, and may be cancelled at any time by such body for cause. Every such permit or a true copy thereof shall be carried in the vehicle to which it refers and shall be open to inspection by any peace officer, and it shall be a misdemeanor for any person to violate any of the terms or conditions of such special permit."

"All Acts or parts of Acts in conflict with this Act are hereby repealed."

"This Act shall be in full force and effect from and after its passage and approval."



# INDEX

	PARAGRAPH	
Accidents - - - - -	1.23	
Accounting - - - - -		Chapter II
Accounts and Codes - - - - -	2.8	
Addresses - - - - -	1.18	
Automobile Operation - - - - -	3.29, 3.30	
Betterments - - - - -	2.11	
Blasting - - - - -	5.1	
Boilers - - - - -	3.35	
Borrowing Equipment - - - - -	3.11	
Bridge Approaches - - - - -	4.9	
Bridges - - - - -	5.2	
Buildings - - - - -	5.3	
Camps - - - - -	5.3	
Claims - - - - -	2.19, 2.23, 2.24, 2.25	
Clearing - - - - -	5.16	
Codes - - - - -	2.8, 2.14, 2.15, 2.18, 2.19	
Correspondence - - - - -	1.20	
Cross Roads - - - - -	4.4	
Crushed Gravel Surfaces - - - - -	4.13	
Crushers - - - - -	3.34	
Culverts - - - - -	5.4	
Detail of Work Orders - - - - -	2.4	
Detours - - - - -	5.5	
Disposal of Equipment - - - - -	3.15	
District Mechanic - - - - -	3.8	
District Shops - - - - -	3.3	
Division Engineers - - - - -	1.6	
Division Mechanics - - - - -	3.7	
Division Offices - - - - -	1.2	
Division Shops - - - - -	3.2	
Drainage - - - - -	4.3, 5.6	
Earth Roads - - - - -	4.12	
Emergencies - - - - -	1.26	
Emergency Purchases - - - - -	2.22	
Employees Accidents - - - - -	1.23	
Employment - - - - -	1.9	
Equipment		
Borrowing - - - - -	3.11	
Clerk - - - - -	3.6	
Department - - - - -		Chapter III
Disposal - - - - -	3.15	
General Operating Instructions - - - - -	3.27	
Manufacturers Instructions - - - - -	3.24	
Operation - - - - -	3.28, 3.29, 3.30, 3.31 3.32, 3.33, 3.34, 3.35	

# INDEX

	Paragraph	
Equipment		
Painting - - - - -	3.23	
Rental - - - - -	3.12, 3.13	
Responsibility & Protection - - - - -	3.9, 4.11	
Salvaging Parts - - - - -	3.25	
Servicing - - - - -	3.20	
Shop Practice - - - - -	3.24	
Shop Tools - - - - -	3.26	
Superintendent - - - - -	1.4, 3.4	
Trial - - - - -	3.14	
Expenses - - - - -	1.17	
Express - - - - -	1.22	
Fences - - - - -	5.7	
Financial Control - - - - -	2.2	
Foremen - - - - -	1.8	
Forms -(Standard) - - - - -	5.25	
Fountains - - - - -	5.12	
Freight and Express - - - - -	1.22	
Frost Boils - - - - -	5.6	
Funds and Accounting - - - - -	2.1	
General Maintenance - - - - -	2.9	
General Purchases - - - - -	2.20	
Grader Operation - - - - -	3.31	
Guard Rail - - - - -	5.9	
Headquarters Office - - - - -	1.1	
Holding Account - - - - -	2.17	
Hours of Labor - - - - -	1.13, 3.17	
Laws - - - - -	1.12, 5.26	
Lug Tractors - - - - -	5.20	
Mail Boxes - - - - -	5.10	
Maintenance Betterments - - - - -	2.11	
Maintenance of Buildings, Yards, Tools - - - - -	3.19	
Maintenance Coding - - - - -	2.16	
Maintenance Engineer - - - - -	1.3	
Maintenance General - - - - -	2.9	
Maintenance Holding Account - - - - -	2.7	
Maintenance Miscellaneous - - - - -		Chapter V
Maintenance Special - - - - -	2.10	
Maintenance Superintendent - - - - -	1.7	
Maintenance Surface - - - - -		Chapter IV
Manufacturers Instructions - - - - -	3.24	
Master Mechanic - - - - -	3.5	
Miscellaneous Coding - - - - -	2.18	
Miscellaneous Reports - - - - -	1.25	
Organization & General Details - - - - -		Chapter I
Oils (Lubricating) - - - - -	3.21	
Oiled Surfaces - - - - -	4.14	
Oiled Stock Piles - - - - -	4.15, 5.18	

INDEX

PARAGRAPH

Oiling Superintendent - - - - -	1.5
Operating Personnel - - - - -	3.28
Operation of Equipment- - - - -	3.27, 3.29, 3.30, 3.31 3.32, 3.33, 3.34, 3.35
Overdrafts - - - - -	2.7
Oversize- - - - -	4.7
Painting - - - - -	3.23
Parts (Salvage) - - - - -	3.25
Patrolmen - - - - -	1.8
Patrolmen's Weekly Report - - - - -	1.15
Pavements - - - - -	4.16
Payrolls - - - - -	1.19
Personal Liability - - - - -	1.23
Personnel Cards - - - - -	1.10
Personnel Employment - - - - -	1.9
Personnel Operation of Equipment - - - - -	3.28
Personnel Protection - - - - -	4.11
Personnel Responsibility - - - - -	1.11
Personnel Responsibility for Equipment - - - - -	3.9
Personnel Qualification of Shop Employees - - - - -	3.16
Plows (Snow)- - - - -	3.33
Proceedure on Work Orders - - - - -	2.5
Purchases (Emergency )- - - - -	2.22
Purchases (Gas, Oil, Grease)- - - - -	2.21
Purchases (General)- - - - -	2.20
Railroad Crossings - - - - -	4.10
Rental of Equipment - - - - -	3.12, 3.13
Reports - - - - -	1.15, 1.25
Requisitions - - - - -	1.24
Responsibility- - - - -	1.11
Retaining Walls - - - - -	5.22
Retorts - - - - -	3.35
Right of Way Fences - - - - -	5.7
Road Approaches - - - - -	5.11
Roadside Fountains- - - - -	5.12
Rock Surfaces - - - - -	4.13
Safety Instructions - - - - -	3.36
Salvage of Parts- - - - -	3.25
Sanding Icy Surfaces- - - - -	5.14
Section Prefixes- - - - -	2.12
Service Stations- - - - -	5.15
Shops - - - - -	3.2, 3.3
Shop Practice - - - - -	3.24
Shop Tools- - - - -	3.26
Shoulders - - - - -	4.6
Sight Clearing- - - - -	5.16
Signs - - - - -	5.17
Slides & Washouts - - - - -	4.5
Snow	
Fences - - - - -	5.7
Removal - - - - -	4.2
Plows - - - - -	3.33



# INDEX

## PARAGRAPH

Source of Funds - - - - -	2.1
Special Maintenance - - - - -	2.10
Standard Forms - - - - -	5.25
State Equipment Accidents - - - - -	1.23
State Property for Private Use - - - - -	3.18
Stock Piles - General - - - - -	5.18
Stock Piles - Oiled - - - - -	4.15
Supplies - - - - -	3.10
Surface Maintenance - - - - -	

## Chapter IV

Telephone and Telegraph - - - - -	1.21
Tire Pressure - - - - -	3.22
Tools (Shop) - - - - -	3.26
Tractor Operation - - - - -	3.32
Tractors with Lugs - - - - -	5.19
Traffic Counts - - - - -	5.20
Transfer of Personnel - - - - -	1.16
Traveling Expenses - - - - -	1.17
Truck Operation - - - - -	3.30

Wage Scale - - - - -	1.14
Walls - Retaining - - - - -	5.22
Warning Posts - - - - -	5.21
Waste Water - - - - -	5.23
Weeds - - - - -	5.24
Windrows - - - - -	4.8
Work Orders - - - - -	2.3, 2.4, 2.5
Working Hours - - - - -	1.13, 3.17















